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Fugitive Emission Testing at the Kosovo Coal Gasification Plant

Radian Corp., Austin, TX

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FUGITIVE EMISSION TESTING
AT THE
KOSOVO COAL GASIFICATION PLANT

by

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16. ABSTRACT

The report summarizes results of a test program to characterize fugitive emissions from the Kosovo coal gasification plant in Yugoslavia, a test program implemented by the EPA in response to a need for representative data on the potential environmental impacts of Lurgi coal gasification technology. Major objectives of this fugitive emissions assessment were to: (1) determine the frequency of leak occurrence, (2) measure leak rates from leak sources, (3) estimate total fugitive emissions from leakage, and (4) compare the results to other fugitive emission test data. Study results show similarities to results of fugitive emission testing in U.S. oil refineries and organic chemical plants. These results indicate that most of the sources tested have very low emission rates, and most total emissions are contributed by a small fraction of the sources. Based on emission factors developed from the test data, Kosovo fugitive sources emit 5.7 kg/day of hydrocarbons. Selected results are: gas valves in clean service leak more than those in dirty gas service, 95 percent confidence intervals on emission factors span two or more orders of magnitude about the mean value, most emissions were from valves in hydrocarbon service followed by flanges in hydrocarbon service, and liquid leaks from pump seals were the largest of any other liquid source.

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ABSTRACT

Fugitive emission testing was partially supported by the U.S. Department of Energy and performed as part of an ongoing cooperative environmental data acquisition program which is being sponsored by the U.S. Environmental Protection Agency. The government of Yugoslavia has provided technical, logistic, and manpower support. The subject of the data acquisition program is a commercial-scale, medium-Btu gasification plant which is currently operating in the province of Kosovo in Yugoslavia. The four major objectives of this assessment of gaseous fugitive emissions were: 1) determination of the frequency of leak occurrence; 2) measurement of leak rates from leaking sources; 3) estimation of total fugitive emissions from leakage; and 4) comparison of the results to other fugitive emission test data. The sources tested included valves, pumps, flanges, and open-ended lines.

The results of this study show similarities to results of fugitive emission testing in the U.S. oil refineries and organic chemical plants. These results indicate that most of the sources tested have very low emission rates, and the majority of the total emissions are contributed by a small fraction of the sources. Based on emission factors developed from the test data, Kosovo fugitive sources emit 5.7 kg/day of hydrocarbons. The environmental concern associated with fugitive emissions is dependent on the composition of the process fluid contained by the source, because the emissions are the result of process fluid leakage from valve packing and seats, pump seals, and flange gaskets.

Fugitive emission controls that have been implemented in the U.S. oil and chemical industry include leak detection/repair strategies and substitution of equipment components with lower leak potential. These controls are also applicable to fugitive emission sources in coal gasification plants and should be considered during the design phase of these plants.

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SECTION 1.0
INTRODUCTION

The Kosovo test program was implemented by the EPA in response to a need for data on the potential environmental impacts of pressurized, oxygen-blown, moving bed coal gasification technology. Because many proposed coal gasification projects in the U.S. are based on Lurgi technology, the EPA is interested in taking appropriate steps to enhance the environmental acceptability of the technology. Previous test efforts at Kosovo have been directed toward characterization of process and discharge streams and also monitoring of ambient air. This report summarizes the results of a test program to characterize gaseous fugitive emissions from the Kosovo coal gasification facility. The objectives and scope of the test program are focused on obtaining data that will facilitate prioritization of future fugitive emission testing. Partial funding for this test was provided by the U.S. Department of Energy.

1.1 OBJECTIVES

Fugitive emissions are generally defined as emissions that are not released through an enclosure such as a duct or vent pipe. Fugitives include process fluid leakage from seals (e.g., valves, pumps, flanges, compressors), process fluid purges (sampling), secondary emission sources (e.g., drains, wastewater systems, cooling towers), and particulate sources such as storage piles and unpaved areas. Process fluid leakage sources were the subject of the testing at Kosovo. The process fluid species analyzed included hydrocarbons, carbon monoxide, hydrogen sulfide, hydrogen cyanide, and ammonia. The four major objectives of this assessment of gaseous fugitive emissions were: 1) determination of the frequency of leak occurrence; 2) measurement of leak rates from leaking sources; 3) estimation of total fugitive emissions from leakage; and 4) comparison of the results to other fugitive emission test data.

Source screening and source sampling were the two types of emission tests that were required in order to fulfill the objectives of the program. Source screening provided a determination of the number of sources leaking and an order of magnitude estimate of their leak rates. Source sampling involved enclosure of a leaking source and measurement of the leak rate from the source. Detailed descriptions of these two types of emission tests are included in Section 3 of this report.

1.2 SCOPE OF WORK

The fugitive emission sources that were selected for investigation in this study were valves, pumps, flanges, and open-ended lines. Open-ended lines are defined as any piping that connects to the open (atmosphere) side of a process valve. Emissions from open-ended lines are the result of valve seat leakage. There are no compressors in hydrocarbon service at the Kosovo plant, and all of the relief valves were inaccessible for testing. In the refinery fugitive emissions study (Reference 3), the emission factor for relief valves was found to be greater than the factor for valves in vapor service, but less than the factor for pumps in light liquid service. Since there were only six inaccessible relief valves at Kosovo, the inability to include them in the screening/sampling effort is not believed to have biased the results significantly. Drains, wastewater separators, and cooling towers were not included because the methodology for testing these sources is not completely developed.

All process lines that contained significant quantities of the compounds of interest were included in the testing in the following process units: 1) gas production and gas cooling; 2) tar/oil separation and by-product storage; 3) acid gas removal (Rectisol); 4) phenolic water treatment (Phenosolvan); 5) gas distribution, and 6) flare (piping within process units). Because of the large number of potential fugitive emission sources present at the Kosovo plant (more than 7800), a random sampling strategy was used in order to insure the representativeness of the data obtained. Approximately 30 percent of the sources accessible for testing were screened to detect the presence of leakage. This sample population (1450 sources) is large enough to permit a comparison of the frequency of leak occurrence at Kosovo to similar data collected at U.S. petroleum refineries and organic chemical plants.

1.3 PROGRAM ORGANIZATION

The program organization for the Kosovo fugitive emission test is shown in Figure 1-1. The prime contractor (Radian) and all subcontractors except the Institute for Applied Nuclear Technology (INEP) were involved in the on-site data acquisition. INEP provided hydrogen and calibration gases for the analytical instruments. Funding for the test program was provided jointly by the U.S. Department of Energy and the U.S. Environmental Protection Agency.

1.4 REPORT ORGANIZATION

Section 2 of this report contains a general description of the Kosovo gasification facility and an overview of the process units and streams included in the test program. The test methodology is described in Section 3 and the results of the testing

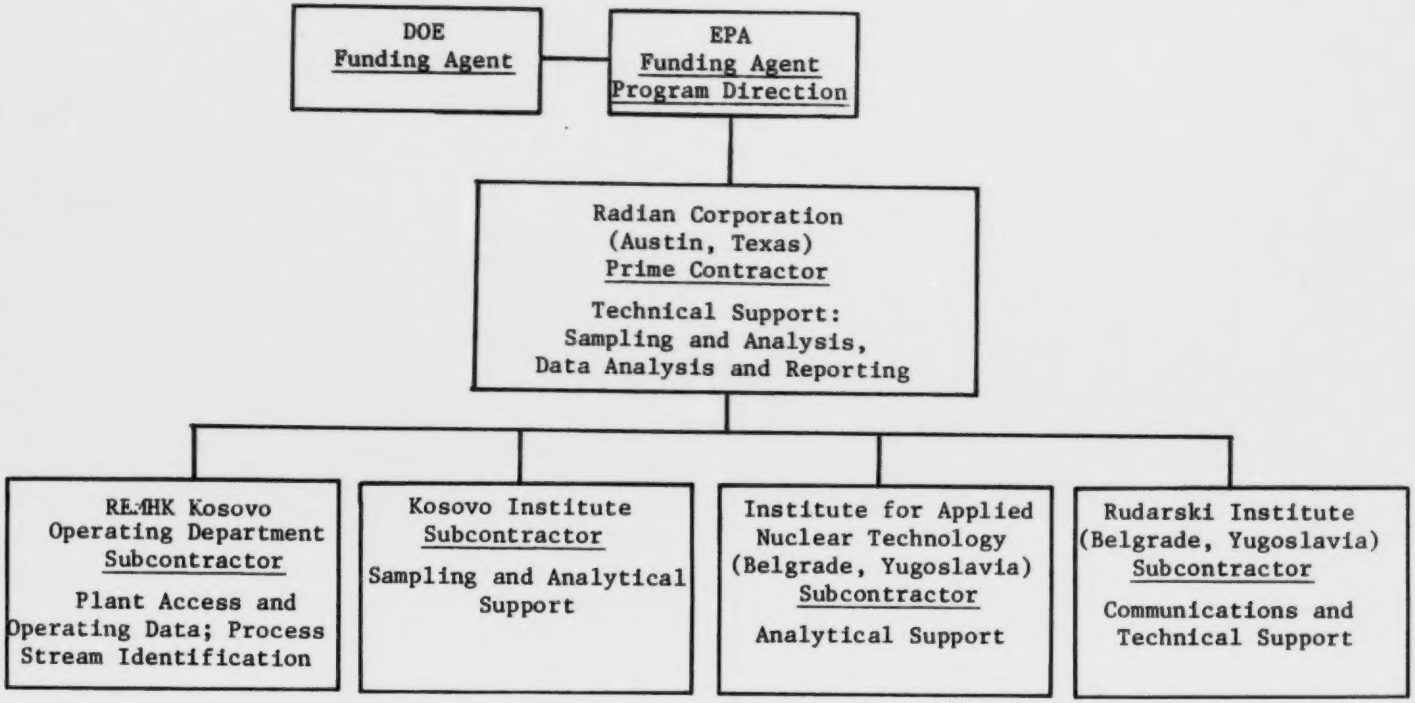

DOE
Funding Agent
EPA
Funding Agent
Program Direction
Radian Corporation
(Austin, Texas)
Prime Contractor
Technical Support:
Sampling and Analysis,
Data Analysis and Reporting
REMHK Kosovo
Operating Department
Subcontractor
Plant Access and
Operating Data; Process
Stream Identification
Kosovo Institute
Subcontractor
Sampling and Analytical
Support
Institute for Applied
Nuclear Technology
(Belgrade, Yugoslavia)
Subcontractor
Analytical Support
Rudarski Institute
(Belgrade, Yugoslavia)
Subcontractor
Communications and
Technical Support

Figure 1-1. Kosovo Fugitive Emission Test - Participating Organizations and Areas of Responsibility

are presented in Section 4. Section 5 provides a summary of the conclusions drawn from the results and recommendations for developing fugitive emission control strategies. The appendices to this report contain detailed test protocol descriptions, analytical instrument technical data, discussions of statistical treatment of the data, examples of data recording forms, and the raw data obtained during the test program.

SECTION 2.0
PLANT DESCRIPTION

This section briefly describes the Kosovo gasification plant and its operating characteristics, and identifies the process units and streams that were included in the fugitive emission testing.

2.1 PROCESS OVERVIEW

A detailed description of the Kosovo coal gasification plant can be found in References 1 and 2. A brief description of the plant is included here in order to illustrate the areas where fugitive emission testing was conducted.

As shown in Figure 2-1, the Lurgi-type gasification facility at Kosovo is an integral part of a large mine-mouth industrial complex. The gasification plant consumes dried lignite and produces two primary products: medium-Btu (13-15 MJ/m^3 @ 25°C) fuel gas and hydrogen for use in ammonia synthesis. The gasification plant also produces several hydrocarbon by-products --tars, medium oil, naphtha, and crude phenols--and aqueous ammonium hydroxide. Figure 2-2 gives the major stream flow rates for the Kosovo gasification plant for the case when five of the six gasifiers are in operation. As is shown in Figure 2-2, the plant is designed to produce 25 metric tons of product gas (65,000 m^3 @ 25°C) per hour for a feed rate of 80 metric tons per hour of dried lignite. At these rates, the gasification plant would be converting approximately 1300 GJ/hr (360 MW) of input coal heat value into 900 GJ/hr (250 MW) of medium-Btu product gas energy (higher heating value basis).

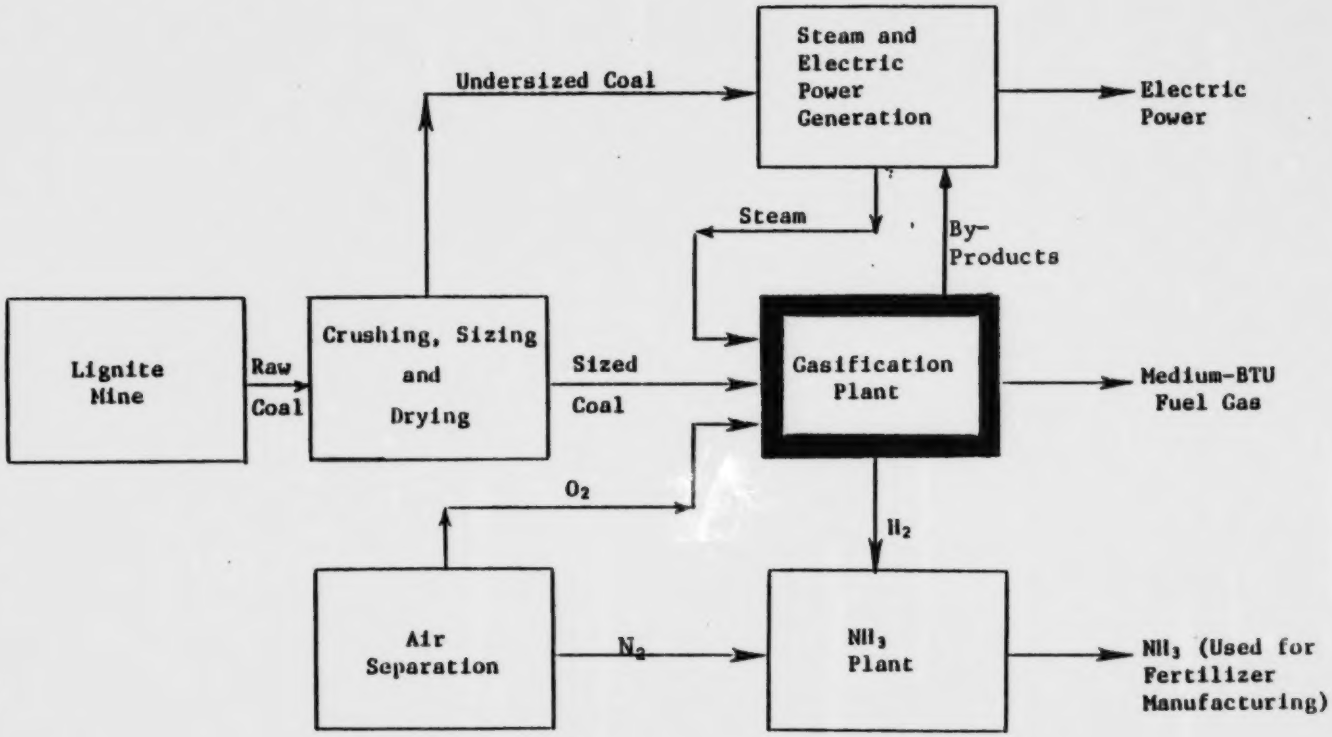

Lignite Mine
Raw Coal
Crushing, Sizing and Drying
Undersized Coal
Sized Coal
Steam and Electric Power Generation
Electric Power
Steam
By-Products
Gasification Plant
Medium-BTU Fuel Gas
O_2
H_2
Air Separation
N_2
NH_3 Plant
NH_3 (Used for Fertilizer Manufacturing)

Figure 2-1. Kosovo Gasification Plant and its Relationship to Surrounding Industries

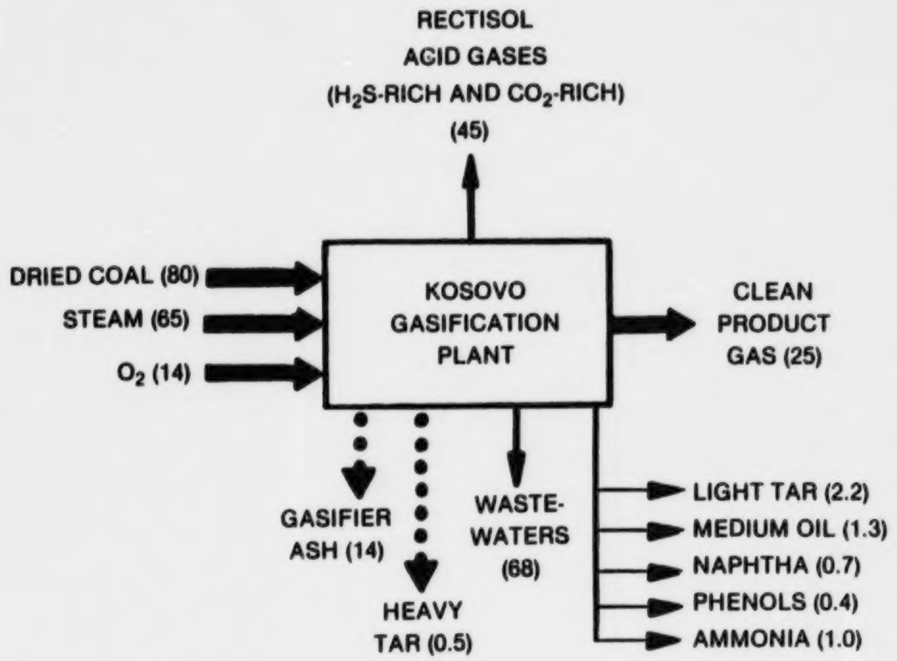

RECTISOL
ACID GASES
(H_2S-RICH AND CO_2-RICH)
(45)
DRIED COAL (80)
STEAM (65)
O_2 (14)
KOSOVO
GASIFICATION
PLANT
CLEAN
PRODUCT
GAS (25)
GASIFIER
ASH (14)
HEAVY
TAR (0.5)
WASTE-
WATERS
(68)
LIGHT TAR (2.2)
MEDIUM OIL (1.3)
NAPHTHA (0.7)
PHENOLS (0.4)
AMMONIA (1.0)

Figure 2-2. Major Stream Flow Rates in the Kosovo Gasification Plant (metric tons/hr), Assuming Five of Six Gasifiers in Service

The major processing units within the gasification plant are shown in Figure 2-3. All of the processing units shown in Figure 2-3 were tested for fugitive emissions except the hydrogen purification unit, which was not in operation during the test period. Section 2.2 gives a brief description of the process units which were tested and the major streams in those units which are potential sources of fugitive emissions.

For data obtained from the Kosovo facility to be properly interpreted, it must be recognized that the Kosovo plant does not include all of the design and operating features of modern Lurgi-type facilities. For example, the Kosovo plant does not employ many of the pollution control processes which will be incorporated in U.S. gasification facilities. Therefore, many of the "uncontrolled" discharges from the Kosovo plant are not representative of the "controlled" discharges from Lurgi-type facilities that will be built in the U.S. The process and "uncontrolled" discharge streams of Kosovo are expected to be similar in composition and relative flow rate to analogous internal streams in future U.S. plants with similar design features. Within these constraints, the data obtained in this study provide a reasonable data base for assessing fugitive emissions for U.S. plants based on similar technology. The reader must, however, carefully consider the design and operational features of the Kosovo facility when extrapolating these fugitive emission results to other plants.

2.2 PROCESS UNIT DESCRIPTION AND MAJOR PROCESS STREAMS

A brief description of the operation of each process unit and the major process streams tested is given below. Fugitive emission sources in each process unit are the pumps, valves, flanges, etc. associated with the major process streams. A detailed process description is presented in Reference 2.

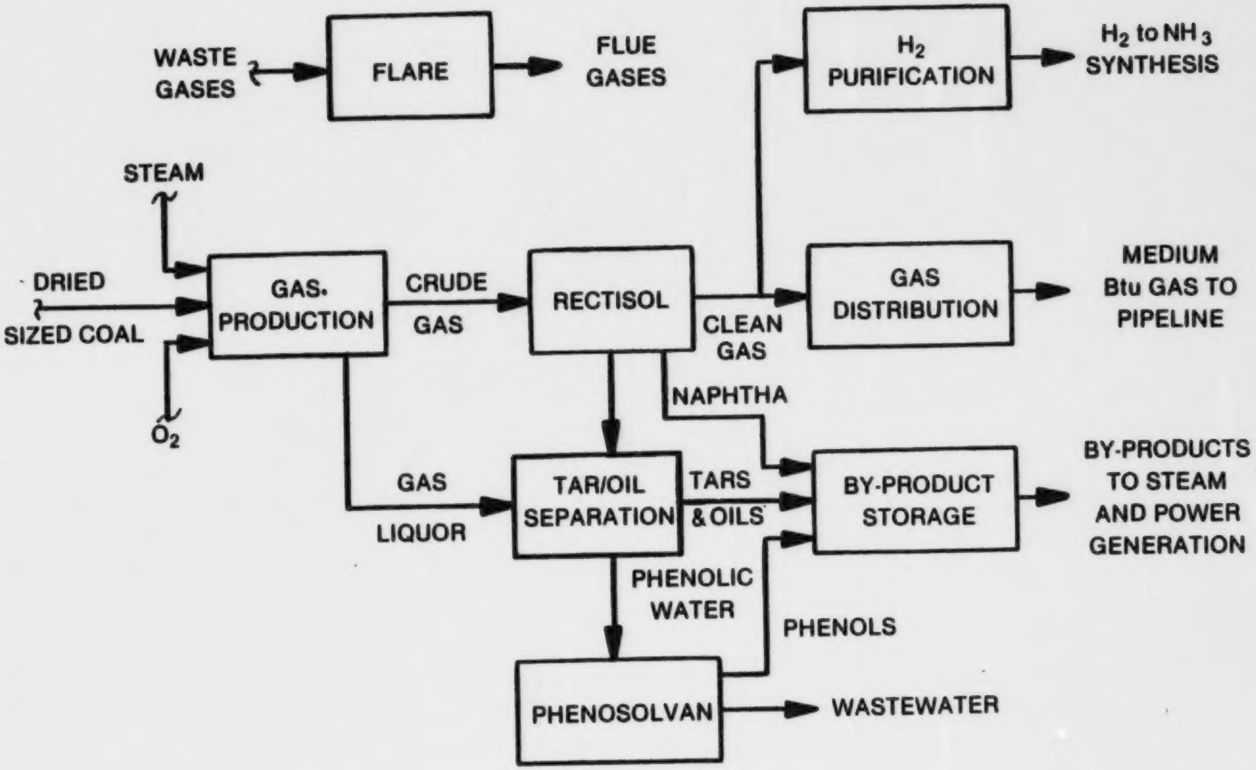

WASTE GASES
FLARE
FLUE GASES
STEAM
DRIED SIZED COAL
O_2
GAS. PRODUCTION
CRUDE GAS
RECTISOL
CLEAN GAS
NAPHTHA
GAS LIQUOR
TAR/OIL SEPARATION
TARS & OILS
PHENOLIC WATER
PHENOSOLVAN
PHENOLS
WASTEWATER
H_2 PURIFICATION
H_2 to NH_3 SYNTHESIS
GAS DISTRIBUTION
MEDIUM Btu GAS TO PIPELINE
BY-PRODUCT STORAGE
BY-PRODUCTS TO STEAM AND POWER GENERATION

Figure 2-3. Simplified Flow Diagram of the Kosovo Coal Gasification Plant

Gas Production and Gas Cooling

In gas production and cooling, the following functions are accomplished:

- the dried coal is gasified to produce crude product gas;
- the crude product gas is cooled and scrubbed to remove entrained coal fines and heavy organics; and
- the ash is removed from the gasifier and quenched.

A simplified process flow diagram for this section is shown in Figure 2-4. Also shown are the section's discharge sources.

There are six pressurized fixed-bed, oxygen-blown, Lurgi-type gasifiers at Kosovo. Dried coal is fed by conveyor belts to coal bunkers located above each gasifier. Nitrogen is used as a purge gas for each bunker to prevent spontaneous ignition of the coal. The coal bunker purge gases are collected in hoods and sent through a scrubber to remove entrained coal dust before being discharged to the atmosphere. The blowdown liquid from the coal bunker vent gas is combined with other wastewaters generated in this section prior to discharge (Stream 12.3).

The operating cycle of the coal feed lock hopper consists of four steps:

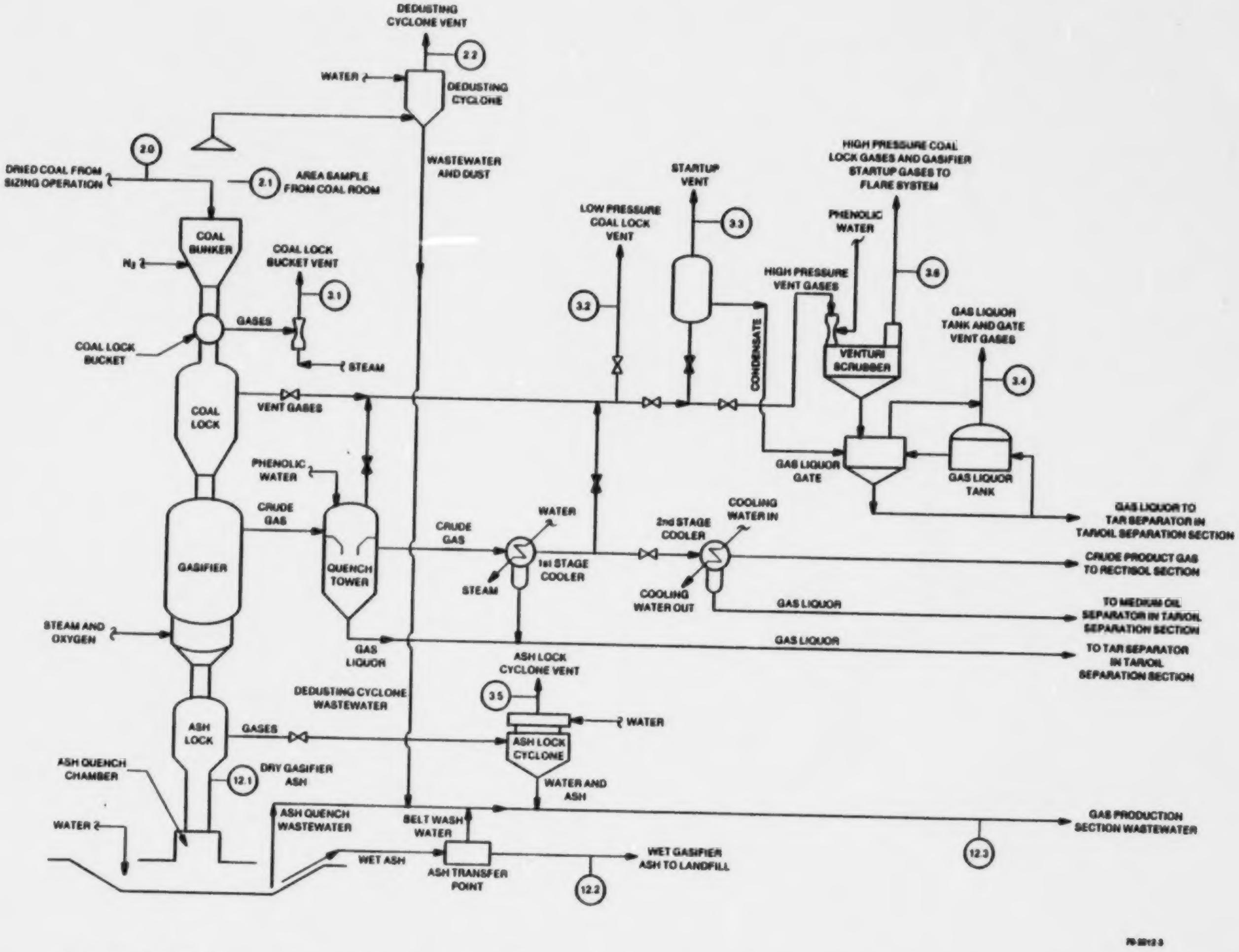

DEDUSTING CYCLONE VENT
2.2
WATER
DEDUSTING CYCLONE
WASTEWATER AND DUST
2.0
DRIED COAL FROM SIZING OPERATION
2.1
AREA SAMPLE FROM COAL ROOM
COAL BUNKER
N₂
COAL LOCK BUCKET VENT
3.1
GASES
STEAM
COAL LOCK BUCKET
COAL LOCK
VENT GASES
PHENOLIC WATER
CRUDE GAS
GASIFIER
QUENCH TOWER
STEAM AND OXYGEN
GAS LIQUOR
LOW PRESSURE COAL LOCK VENT
3.2
STARTUP VENT
3.3
CONDENSATE
HIGH PRESSURE COAL LOCK GASES AND GASIFIER STARTUP GASES TO FLARE SYSTEM
PHENOLIC WATER
HIGH PRESSURE VENT GASES
3.6
VENTURI SCRUBBER
GAS LIQUOR TANK AND GATE VENT GASES
3.4
GAS LIQUOR GATE
GAS LIQUOR TANK
GAS LIQUOR TO TAR SEPARATOR IN TAR/OIL SEPARATION SECTION
CRUDE GAS
WATER
STEAM
1st STAGE COOLER
2nd STAGE COOLER
COOLING WATER IN
COOLING WATER OUT
CRUDE PRODUCT GAS TO RECTISOL SECTION
GAS LIQUOR
TO MEDIUM OIL SEPARATOR IN TAR/OIL SEPARATION SECTION
GAS LIQUOR
TO TAR SEPARATOR IN TAR/OIL SEPARATION SECTION
ASH LOCK CYCLONE VENT
3.5
WATER
ASH LOCK CYCLONE
WATER AND ASH
DEDUSTING CYCLONE WASTEWATER
ASH LOCK
GASES
ASH QUENCH CHAMBER
12.1
DRY GASIFIER ASH
WATER
ASH QUENCH WASTEWATER
BELT WASH WATER
WET ASH
ASH TRANSFER POINT
12.2
WET GASIFIER ASH TO LANDFILL
12.3
GAS PRODUCTION SECTION WASTEWATER

Figure 2-4. Process Flow Diagram - Gas Production and Cooling
Note: Stream numbers refer to sampling points in Source Test and Evaluation Reports (References 1 and 2).

- filling the hopper with coal,
- pressurizing the coal lock,
- feeding the coal to the gasifier, and
- depressurizing the coal lock.

Coal enters the coal lock from the coal bunker through a transition section which is referred to as a coal lock bucket. Gases displaced by the coal during the charging cycle are vented to the atmosphere through the coal lock bucket vent (Stream 3.1). When the coal lock bucket vent becomes plugged with coal dust and tar, these gases are released through the low pressure coal lock vent (Stream 3.2).

After the coal lock is filled with coal, it is pressurized with crude product gas. When the coal lock has reached operating pressure, the valve separating the coal lock from the gasifier is opened and coal enters the gasifier from the coal lock.

When all the coal in the lock hopper has been added to the gasifier, the valve separating the coal lock from the gasifier is closed and the coal lock is depressurized. In the initial stages of coal lock depressurization, high pressure gas is sent to the flare system (Stream 3.6). Then, after the gas pressure in the coal lock has been reduced to around 0.2 MPa (2 atmospheres), residual lock gases are vented directly to the atmosphere (Stream 3.2).

Steam and oxygen injected at the bottom of each gasifier react with the coal to produce a hot, crude product gas at 2.5 MPa (25 atmospheres). This gas exits the top of each gasifier and is quenched directly with water. The gas is then cooled further in a series of indirect heat exchangers. After cooling, the gas is routed to the Rectisol section for purification. Condensed organic liquids and process condensate generated during the quenching and cooling processes are sent to the tar/oil separation section.

Hot ash generated during gasification is collected from the bottom of each gasifier in a lock hopper. This ash is water-quenched and discharged (along with power plant ash) to a landfill. Ash quench blowdown water is combined with the coal bunker scrubber blowdown and discharged (Stream 12.3). Ash lock expansion gases are routed through a water-washed cyclone to remove entrained particulate matter. These gases are then discharged to the atmosphere (Stream 3.5). The wastewater and ash discharged from this cyclone are combined with the two previously mentioned wastewater streams and discharged (Stream 12.3).

The process streams which were tested in the gas production and gas cooling units are listed below:

- raw product gas,
- phenolic water, and
- gas condensate.

Tar/Oil Separation

The tar/oil separation section is shown in Figure 2-5. In the tar/oil separation section, heavy tar, light tar, and medium oil are separated from the crude gas quench liquor and from the condensate produced by cooling the crude gas. This is accomplished by depressurization of quench liquor and condensate, followed by a series of phase separators. Light tar and medium oil are sent to by-product storage to be used as boiler fuel.

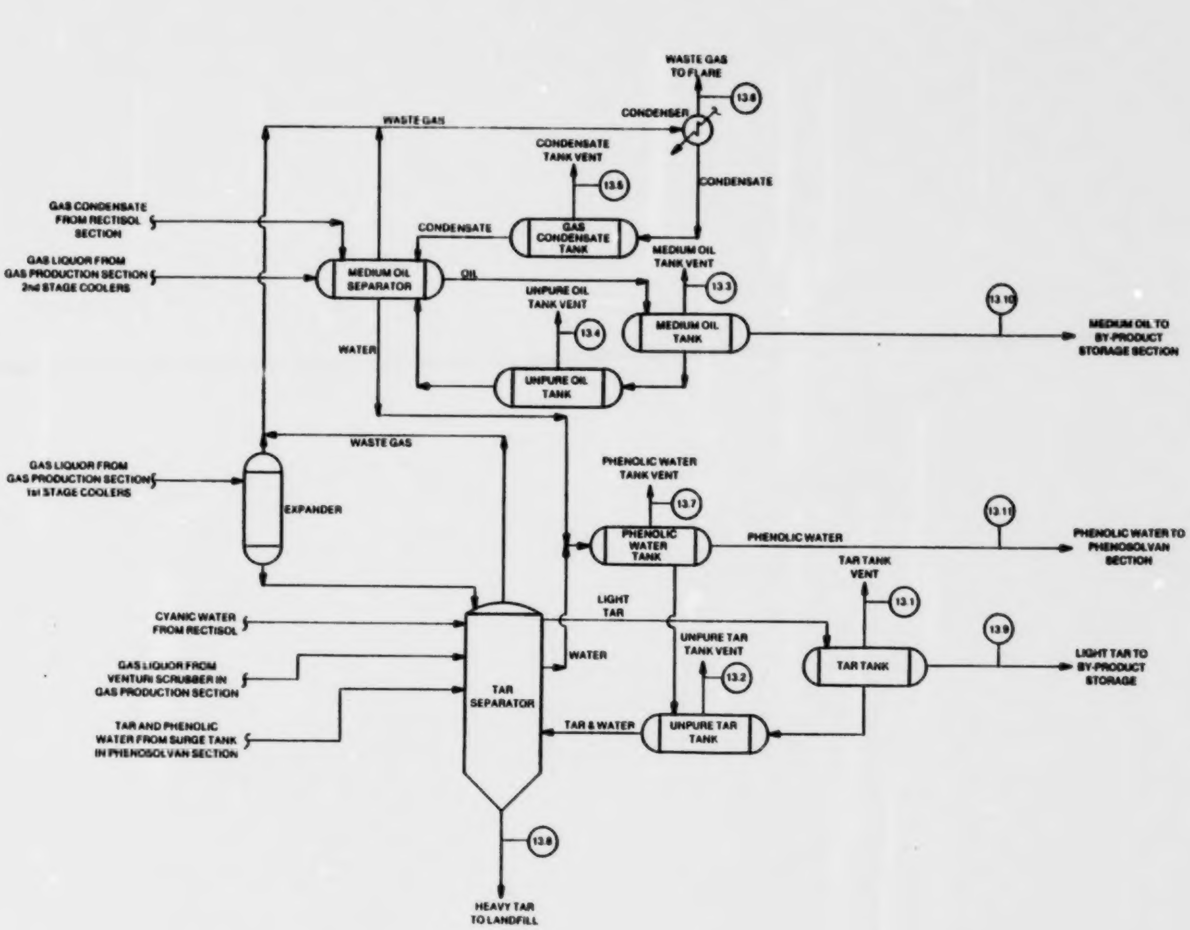

WASTE GAS TO FLARE
13.6
CONDENSER
WASTE GAS
CONDENSATE TANK VENT
13.5
CONDENSATE
GAS CONDENSATE FROM RECTISOL SECTION
GAS LIQUOR FROM GAS PRODUCTION SECTION 2nd STAGE COOLERS
CONDENSATE
GAS CONDENSATE TANK
MEDIUM OIL TANK VENT
13.3
MEDIUM OIL SEPARATOR
OIL
UNPURE OIL TANK VENT
13.4
MEDIUM OIL TANK
13.10
MEDIUM OIL TO BY-PRODUCT STORAGE SECTION
WATER
UNPURE OIL TANK
WASTE GAS
GAS LIQUOR FROM GAS PRODUCTION SECTION 1st STAGE COOLERS
EXPANDER
PHENOLIC WATER TANK VENT
13.7
PHENOLIC WATER TANK
PHENOLIC WATER
13.11
PHENOLIC WATER TO PHENOSOLVAN SECTION
TAR TANK VENT
13.1
LIGHT TAR
CYANIC WATER FROM RECTISOL
UNPURE TAR TANK VENT
13.2
13.9
WATER
TAR TANK
LIGHT TAR TO BY-PRODUCT STORAGE
GAS LIQUOR FROM VENTURI SCRUBBER IN GAS PRODUCTION SECTION
TAR SEPARATOR
TAR AND PHENOLIC WATER FROM SURGE TANK IN PHENOSOLVAN SECTION
TAR & WATER
UNPURE TAR TANK
13.8
HEAVY TAR TO LANDFILL

Figure 2-5. Process Flow Diagram - Tar/Oil Separation
Note: Stream numbers refer to sampling points in Source Test and Evaluation Reports (References 1 and 2).

Heavy tar (Stream 13.8) is landfilled at Kosovo; however, current plans for U.S. plants are to recycle this tar to a gasifier or to use it as boiler fuel. The aqueous phase from the separators is routed to Phenosolvan for phenol recovery. There are six tank vents discharging directly to the atmosphere (Streams 13.1 through 13.5, and 13.7). Expansion and waste gases (Stream 13.6) are sent to the flare system.

The process streams tested in tar/oil separation are listed below:

- tar separation expansion gas,
- gas condensate,
- tar,
- medium oil, and
- phenolic water.

Acid Gas Removal (Rectisol)

In the Rectisol section, acid gases such as H_2S, CO_2, and HCN are removed from the product gas. A process flow diagram for the Rectisol section is presented in Figure 2-6.

Cooled crude product gas (Stream 7.3) at about 22°C (72°F) and 2.3 MPa (23 atm) enters the Rectisol section from the gas production and cooling section. The gas is then cooled further by washing with cold water followed by cold methanol. Condensed liquids generated during this cooling include an organic phase (naphtha) and an aqueous phase. The naphtha (Stream 7.6) is sent to the by-product storage section while the aqueous stream (Stream 7.5) is sent to the tar/oil separation section.

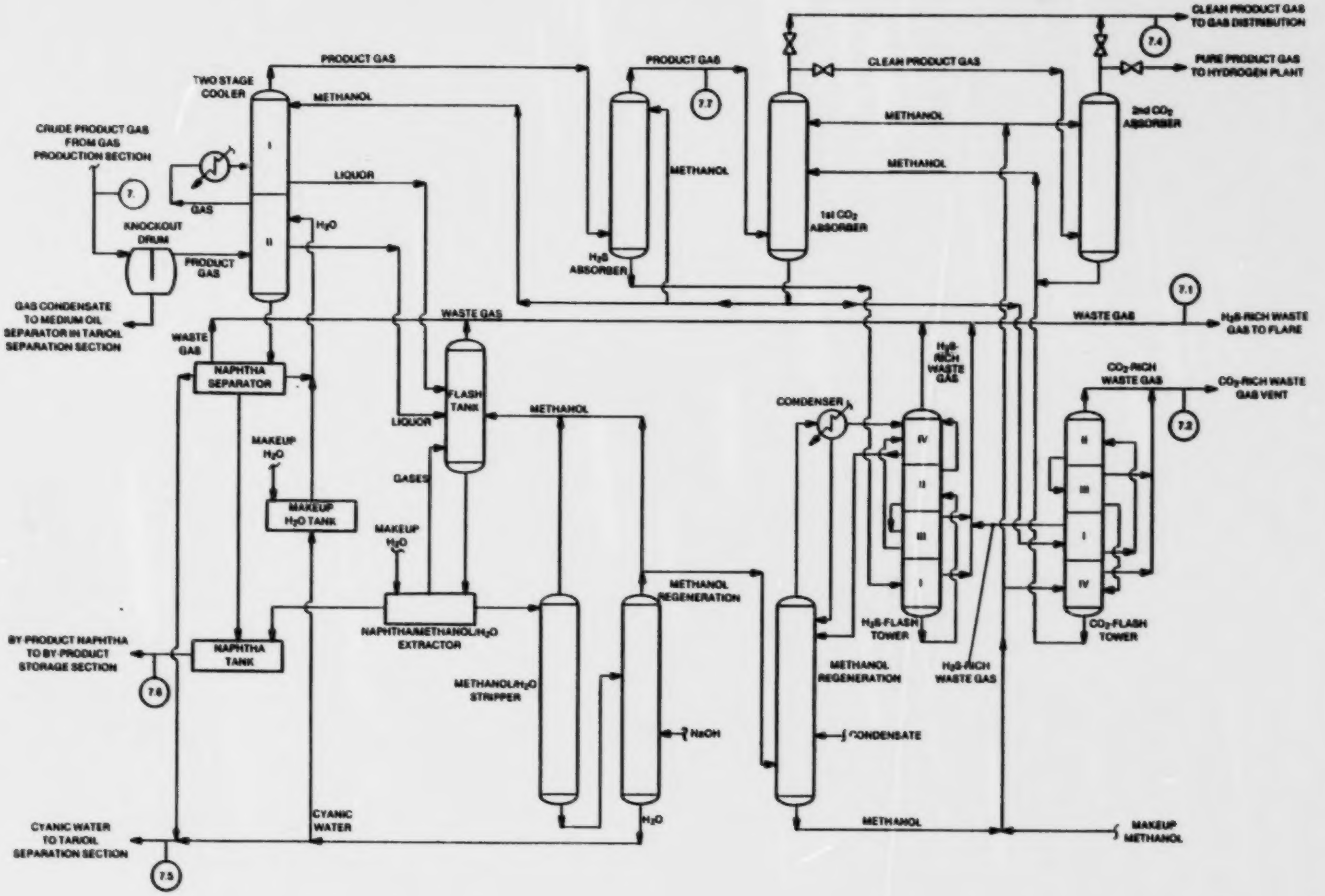

CLEAN PRODUCT GAS TO GAS DISTRIBUTION
7.4
PURE PRODUCT GAS TO HYDROGEN PLANT
PRODUCT GAS
PRODUCT GAS
CLEAN PRODUCT GAS
TWO STAGE COOLER
METHANOL
METHANOL
METHANOL
METHANOL
7.7
2nd CO_2 ABSORBER
CRUDE PRODUCT GAS FROM GAS PRODUCTION SECTION
7.
LIQUOR
GAS
H_2O
KNOCKOUT DRUM
PRODUCT GAS
1st CO_2 ABSORBER
H_2S ABSORBER
7.1
GAS CONDENSATE TO MEDIUM OIL SEPARATOR IN TAR/OIL SEPARATION SECTION
WASTE GAS
WASTE GAS
WASTE GAS
H_2S-RICH WASTE GAS TO FLARE
H_2S-RICH WASTE GAS
CO_2-RICH WASTE GAS
CO_2-RICH WASTE GAS VENT
7.2
NAPHTHA SEPARATOR
FLASH TANK
LIQUOR
METHANOL
CONDENSER
MAKEUP H_2O
GASES
MAKEUP H_2O TANK
MAKEUP H_2O
METHANOL REGENERATION
NAPHTHA/METHANOL/H_2O EXTRACTOR
H_2S-FLASH TOWER
CO_2-FLASH TOWER
BY PRODUCT NAPHTHA TO BY PRODUCT STORAGE SECTION
NAPHTHA TANK
7.6
METHANOL/H_2O STRIPPER
METHANOL REGENERATION
H_2S-RICH WASTE GAS
NaOH
CONDENSATE
CYANIC WATER TO TAR/OIL SEPARATION SECTION
CYANIC WATER
H_2O
METHANOL
MAKEUP METHANOL
7.5
I
II
IV
II
III
I
II
III
I
IV

Figure 2-6. Process Flow Diagram - Acid Gas Removal (Rectisol)
Note: Stream numbers refer to sampling points in Source Test and Evaluation Reports (References 1 and 2).

After cooling, the crude product gas is scrubbed with cold methanol in the H_2S absorber. H_2S-rich waste gas (Stream 7.1) is released from the H_2S-rich methanol during the methanol regeneration process and is routed to the flare system.

The H_2S-lean product gas goes to two CO_2 absorbers. In these columns the bulk of the CO_2 remaining in the product gas is absorbed by a wash of CO_2-laden methanol. The overhead gas from the first CO_2 absorber is fed directly into the fuel gas distribution system. The second CO_2 absorber is used to remove additional CO_2 whenever 'pure' product gas is needed for feed to the cryogenic hydrogen separation unit.

The process streams tested in the Rectisol unit are listed below:

- raw product gas,
- clean product gas,
- H_2S-rich acid gas,
- CO_2-rich acid gas,
- oil water,
- cyanic water,
- methanol, and
- naphtha.

Phenolic Water Treatment (Phenosolvan)

In the phenol removal section (Phenosolvan), phenolic water from the tar/oil separation section is treated to remove residual tars and oils, dissolved gases (principally ammonia), and dissolved organics (principally phenols). A process flow diagram of the Phenosolvan section is shown in Figure 2-7.

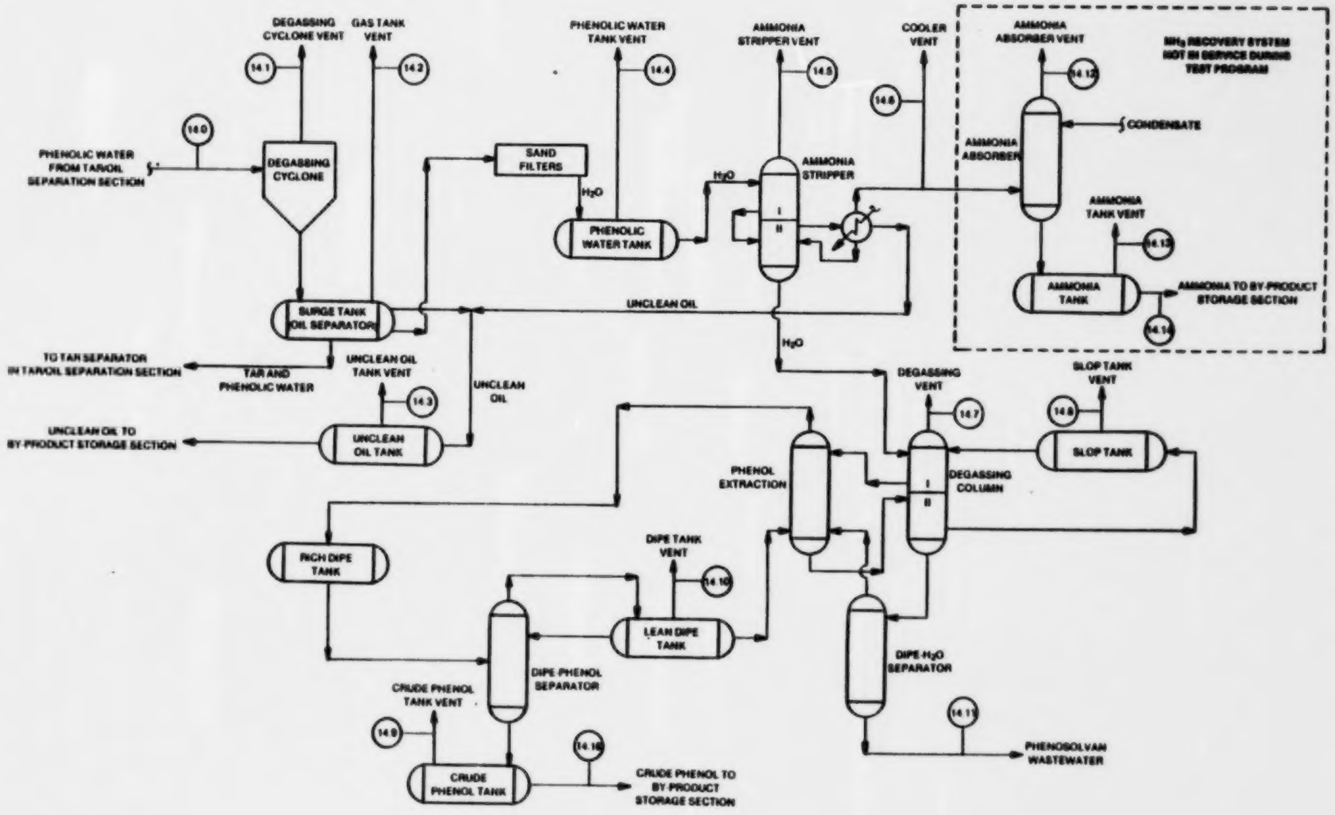

DEGASSING CYCLONE VENT
GAS TANK VENT
PHENOLIC WATER TANK VENT
AMMONIA STRIPPER VENT
COOLER VENT
AMMONIA ABSORBER VENT
NH_3 RECOVERY SYSTEM NOT IN SERVICE DURING TEST PROGRAM
14.1
14.2
14.4
14.5
14.6
14.12
14.0
PHENOLIC WATER FROM TAR/OIL SEPARATION SECTION
DEGASSING CYCLONE
SAND FILTERS
H_2O
H_2O
AMMONIA STRIPPER
AMMONIA ABSORBER
CONDENSATE
PHENOLIC WATER TANK
I
II
AMMONIA TANK VENT
14.13
SURGE TANK OIL SEPARATOR
UNCLEAN OIL
AMMONIA TANK
AMMONIA TO BY-PRODUCT STORAGE SECTION
14.14
H_2O
TO TAR SEPARATOR IN TAR/OIL SEPARATION SECTION
TAR AND PHENOLIC WATER
UNCLEAN OIL TANK VENT
14.3
UNCLEAN OIL
DEGASSING VENT
14.7
SLOP TANK VENT
14.8
UNCLEAN OIL TO BY-PRODUCT STORAGE SECTION
UNCLEAN OIL TANK
PHENOL EXTRACTION
DEGASSING COLUMN
I
II
SLOP TANK
RICH DIPE TANK
DIPE TANK VENT
14.10
LEAN DIPE TANK
DIPE-H_2O SEPARATOR
DIPE-PHENOL SEPARATOR
CRUDE PHENOL TANK VENT
14.9
14.16
14.11
CRUDE PHENOL TANK
CRUDE PHENOL TO BY PRODUCT STORAGE SECTION
PHENOSOLVAN WASTEWATER

Figure 2-7. Process Flow Diagram - Phenolic Water Treatment (Phenosolvan)
Note: Stream numbers refer to sampling points in Source Test and Evaluation Reports (References 1 and 2).

The phenolic water enters the Phenosolvan section through a degassing cyclone where dissolved gases are released and vented to the atmosphere. The water is then routed through a storage tank/gravity separator, and a series of sand filters to remove residual tars and oils. Oils collected from the surface of the stored wastewater are sent to the by-product storage section while the tars and filter backwash water are returned to the tar/oil separation section.

After removal of residual tars and oils, the phenolic water is heated and fed to two degassing columns. In these columns, dissolved gases such as NH_3, CO_2, and H_2S are steam-stripped from the water. The phenol-rich water leaving the degassing columns is routed through a series of heat exchangers and then through extraction columns to remove phenols by extraction with di-isopropyl ether (DIPE). The phenol-rich DIPE is thermally regenerated by distillation, producing lean DIPE which is recycled to the extraction section. The crude phenols which are separated from the DIPE during the regeneration process are sent to the by-product storage section.

The process streams tested in the Phenosolvan unit are:

- phenolic water,
- crude phenol,
- di-isopropyl ether,
- di-isopropyl ether and water,
- oily water, and
- tar.

By-Product Storage

The by-product storage section is designed to store the liquid by-products generated in the tar/oil separation, Phenosolvan, and Rectisol sections. The by-products stored in this section are light tar, medium oil, naphtha, crude phenol, and unclean oil. By-product NH_4OH is also supposed to be stored in this section; however, this by-product was not being recovered during the test program. A process flow diagram of the by-product storage section is shown in Figure 2-8.

There are six discharge sources in the by-product storage section. All of these sources are tank vents discharging vapors to the atmosphere.

The pumps and process pipe fittings associated with the by-product storage tanks are potential sources of fugitive emissions.

Gas Distribution

The purified medium-Btu product gas from the Rectisol unit flows to a pipe manifold where it is metered and sent to a nearby city. This distribution point contains several large motor-operated valves, other small block valves and piping, and a gas sampling station. This system is a potential source of fugitive emissions of clean product gas.

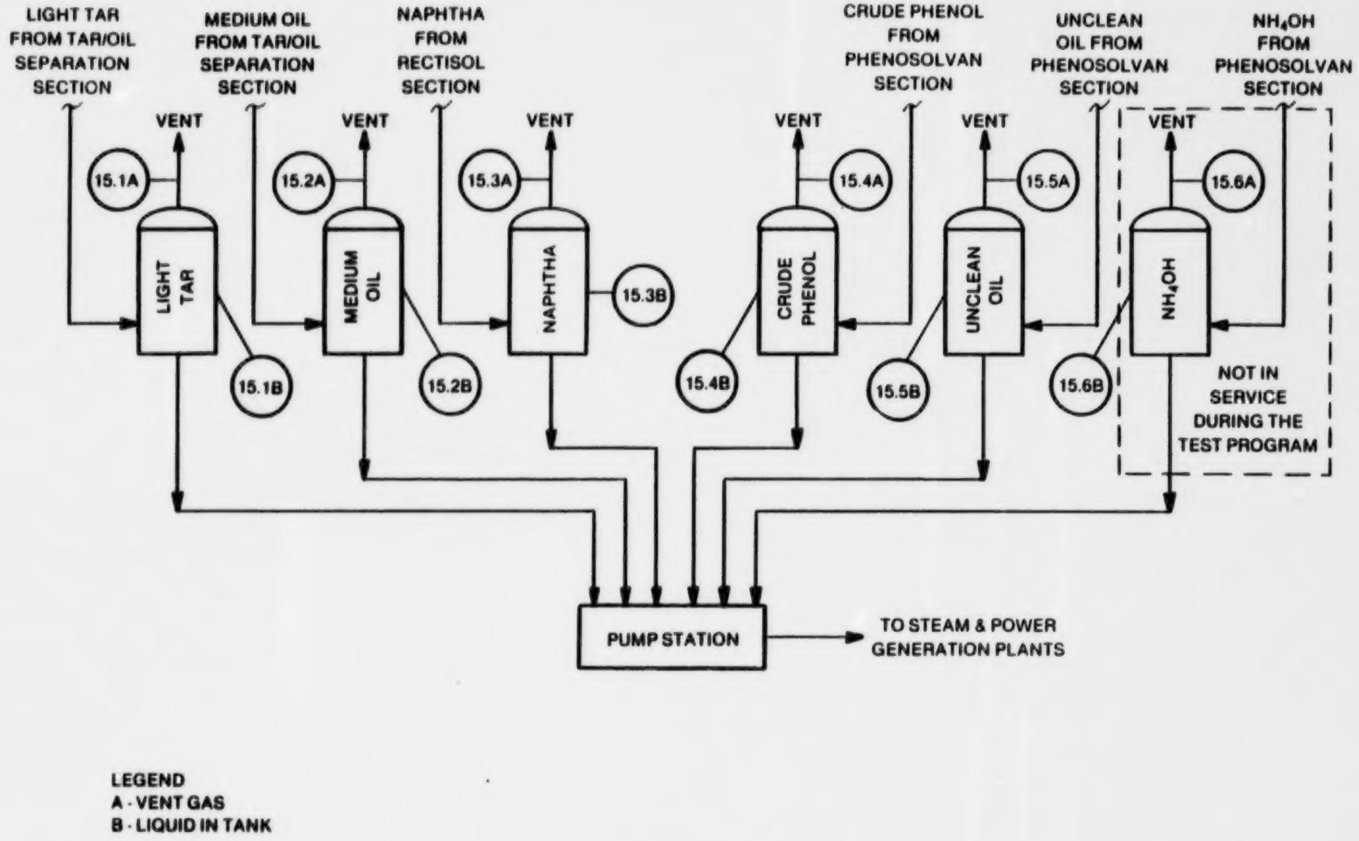

LIGHT TAR FROM TAR/OIL SEPARATION SECTION
MEDIUM OIL FROM TAR/OIL SEPARATION SECTION
NAPHTHA FROM RECTISOL SECTION
CRUDE PHENOL FROM PHENOSOLVAN SECTION
UNCLEAN OIL FROM PHENOSOLVAN SECTION
NH4OH FROM PHENOSOLVAN SECTION
VENT
VENT
VENT
VENT
VENT
VENT
15.1A
15.2A
15.3A
15.4A
15.5A
15.6A
LIGHT TAR
MEDIUM OIL
NAPHTHA
CRUDE PHENOL
UNCLEAN OIL
NH4OH
15.1B
15.2B
15.3B
15.4B
15.5B
15.6B
NOT IN SERVICE DURING THE TEST PROGRAM
PUMP STATION
TO STEAM & POWER GENERATION PLANTS
LEGEND
A - VENT GAS
B - LIQUID IN TANK

Figure 2-8. Process Flow Diagram - By-Product Storage
Note: Stream numbers refer to sampling points in Source Test and Evaluation Report (References 1 and 2).

Flare

Streams routed to the flare are:

- high pressure coal lock expansion gases from the gas production and cooling section (Stream 3.6),
- gasifier startup gases from the gas production and cooling section (Stream 3.6),
- H_2S-rich waste gas from the Rectisol section (Stream 7.1), and
- expansion and waste gases generated in the tar/oil separation section (Stream 13.6).

Fugitive emissions testing was performed on the various waste gas streams within each unit which are routed to the flare system. The emissions from the flare itself are not considered fugitive emissions, and were not tested during this work.

SECTION 3.0
TEST DESCRIPTION

The Kosovo fugitive emission test program included source screening and source sampling. Because of the large number of potential emissions sources and process streams at the Kosovo plant, budget and time constraints prevented inclusion of all sources. A test strategy was developed in order to ensure that the data collected would be representative of the total population of sources. The major elements of the test strategy implemented are:

- use of Kosovo plant personnel to assist in process stream identification,
- random selection of the sources to be screened (e.g., screen every other gas valve encountered),
- source screening using equipment and techniques which were proven in refinery and chemical plant fugitive emissions testing,
- random selection of screened sources within each screening value range for sampling (e.g., put a ticket in a box for each gas valve with a screening value between 1000 ppmv and 10,000 ppmv and determine which to sample by drawing tickets), and
- quality control measures.

3.1 PROCESS STREAM IDENTIFICATION

The first activity performed at the plant site was to identify all of the process streams in the process units. The Kosovo process operator at each unit escorted the sampling teams through the unit and identified the process streams. Paint was applied to the valves and flanges on each line identified, with different colors applied to gas and liquid service sources. The process streams listed in Section 2.2 were assigned code numbers during the stream identification survey. These stream code numbers were written on tags that were then attached to the process lines in order to facilitate identification of the streams during screening and sampling activities.

3.2 SELECTION OF SOURCES TO BE SCREENED

Source populations were determined by counting the sources on the process lines (identified by paint color) in gas or liquid service. These population categories (valve/gas, flange/liquid, etc.) were used to determine the fraction of each population that could be screened within the time constraints of the program. All pumps were screened, and a majority of the valves in gas and liquid service were screened. Fify percent of all open-ended lines were screened. The fraction of flanges screened varied in each unit, with the criterion set as a minimum of 20 gas service and 20 liquid service flanges in each unit. The number of sources inaccessible for testing was also determined, in order to compute an overall estimate of fugitive emissions from the plant. The number of sources screened in each process unit is shown in Table 3-1.

TABLE 3-1. NUMBER OF ACCESSIBLE SOURCES SCREENED ON KOSOVO PROCESS UNITS

Process Unit	Source Type Valves Gas	Valves Liquid	Flanges Gas	Flanges Liquid	Pumps	Open-Ended Lines
Gasification (2 of 6 gasifiers)						
Number of sources	86	140	164	128	6	18
Number of screened	50	63	20	20	6	9
Percent screened	58	45	12	16	100	50
Rectisol						
Number of sources	143	536	396	1011	35	56
Number screened	116	254	19	40	35	28
Percent screened	81	47	5	4	100	50
Phenosolvan						
Number of sources	19	282	44	791	15	48
Number screened	6	164	15	31	14	24
Percent screened	32	58	34	4	93	50
Gas Cooling (2 of 3 cooling trains)						
Number of sources	70	64	170	70	0	8
Number screened	49	38	17	20	-	4
Percent screened	70	59	10	29	-	50
Tar Separation						
Number of sources	33	221	78	448	14	22
Number screened	33	109	27	48	14	11
Percent screened	100	49	35	11	100	50
TOTAL						
Number of sources	321	1243	852	2448	70	132
Number screened	254	628	98	159	69	66
Percent screened	79	51	12	6	99	50

3.3 SOURCE SCREENING

The term "screening," as used here, refers to a measurement of the ambient concentration of a pollutant close to the point of potential leakage, such as at a valve stem or a pump seal. A Century Systems OVA-108 portable flame ionization detector was used to screen sources for hydrocarbon leakage. Draeger® tubes were used to screen for CO, H_2S, NH_3, and HCN. The OVA-108 utilizes a continuous battery operated sampling pump, while the Draeger® tubes require a hand held bellows device to draw the sample into the detector tube. A general description of the screening procedures is given below. The detailed screening protocol is included in Appendix A.

Each selected source was first screened with the OVA-108. The sampling probe tip was placed as close as possible to the point of potential leakage. A slow traverse of the circumference of the potential leak area was made and the maximum concentration detected was noted as the "screening value" for the source. For some sources, the reading fluctuated considerably. In these cases, the screening value recorded was the maximum repeatable concentration observed. The OVA-108 readout scale indicates from 1 to 10,000 ppmv. This range was extended to 100,000 ppmv using a dilution probe attachment that was calibrated for 10/1 dilution of the sample. A response suppression effect was observed when screening gas service sources with screening values above 5000 ppmv, possibly due to the presence of CO and hydrogen. This potential problem was avoided by using the dilution probe to screen all sources where the screening value was above 1000 ppmv.

After the point of maximum leakage was located by screening with the OVA, selected Draeger® tubes were used to screen the source. The selection of appropriate Draeger® tubes was determined by using a ratio of the relative concentrations of pollutants detected by the OVA and Draeger® tubes. For example, if the ratio of hydrocarbon to H_2S in a stream was expected to be 100/1 and the maximum hydrocarbon concentration observed with the OVA was 50,000 ppmv, a Draeger® tube capable of detecting H_2S concentrations in the range of 500 ppmv (50,000/100) would be used.

The data obtained during the screening procedure were recorded directly onto computer keypunch coding forms. In addition to the observed screening values, the date, team number, process unit, source type, stream code and comments were recorded on these data sheets. An example of the screening data sheet is included in Appendix D. Comment codes were recorded to document liquid leaks, variable readings and any other important considerations.

3.4 SOURCE SAMPLING

Source sampling required enclosure ("tenting") of the leaking source and measurement of the rate of leakage from the source. Emission rates were determined from sampling data by the following procedure:

Leak rate = (measured air flow through enclosure) x (measured pollutant concentration in enclosure outlet stream)

The two types of methods for measuring leak rates are the vacuum method and the blow-through method. In the vacuum method, a vacuum pump is used to induce a flow of air through the leak enclosure. Measurements of the flow rate, temperature, pressure, sample concentration and ambient concentration of each pollutant allow the calculation of mass emissions. Maintenance of a pressure slightly below atmospheric on the enclosure virtually insures that the leaking pollutants will be contained in the system, regardless of the tightness of the tent seal.

This method is accurate in the lower leak range, but it has a limited capacity to measure very large leaks (greater than 0.5 kg/hr) (Reference 3). The vacuum and sampling pumps may be driven by either electricity or compressed air. A cold trap is used to condense heavier hydrocarbons before they enter the sampling train to prevent sample loss and sample contamination. The condensed hydrocarbons are measured and added to the calculated vapor emission rate.

In the blow-through method, a regulated stream of compressed air is cleaned by a filter and activated carbon, the flow rate measured, and routed to the enclosure (tent). Because samples are taken from the tent outlet to determine the concentration of various pollutants, a cold trap is not needed to prevent contamination of the sampling train. This method uses more compact equipment, is quicker, and can measure a wider range of leak rates more easily than the vacuum method. The blow-through technique does, though, require a compressed air source and is more subject to error, since pollutants may be lost from the tent due to the positive pressure. However, if there is adequate mixing inside the tent, leakage will not affect the accuracy of the leak rate measurement (the outlet stream and any leakage would have the same composition, and the total rate is measured on the inlet side).

During this test, the blow-through method was used because of the compactness of the equipment, the speed of the procedure, and the capability of measuring large leaks. The detailed source sampling protocol is included in Appendix B.

Sources were selected for sampling after the source screening was completed. Random selections were made from populations of sources within each screening value range. Each source was marked by attaching a numbered tag during the screening operation, and a duplicate numbered tag was used for making the random selections for sampling. The tags from each type of source (e.g., liquid valve, gas flange) were divided into groups based on the following ranges of screening values (OVA readings, ppmv): a) 500 to 5000; b) 5000 to 10,000; c) 10,000 to 100,000; and d) over 100,000. Due to the limited amount of time available, the sampled population was weighted toward higher screening values, and no sources were sampled with screening values less than 500. Previous studies have shown that higher screening sources are the major contributors to the total mass of fugitive emissions (Reference 3).

After a source had been selected for sampling, it was located in the process unit and the sampling equipment was assembled as close to the source as possible. The source was screened with the OVA and Draeger® tubes immediately before and after sampling. The source was enclosed by constructing a tent of Mylar plastic around the potential leak areas. Tape was used to seal all of the seams of the plastic film to prevent leakage from the enclosure. Bulkhead fittings in the enclosure permitted attachment of the blow-through sampling module and collection of the sample for analysis. The sampling module, described in detail in Appendix B, provided a metered flow of purified air to the enclosed leak source. The air was allowed to flow through the leak enclosure until equilibrium was reached. Approach to equilibrium was determined by monitoring the pollutant concentration at the enclosure exit bulkhead fitting. In addition to waiting for a stable exit concentration, the enclosure was also checked for leakage and stratification in order to assure proper leak rate measurement.

When equilibrium was reached in the enclosure, a Mylar bag was filled with vapor from the enclosure exit, purged, and refilled. The OVA was used to measure the hydrocarbon concentration in the bag, and Draeger® tubes were used for the other species present in the sample. Previous fugitive emission test programs have used a laboratory-type flame ionization detector (FID) to analyze hydrocarbons in the bag samples. Because of the way the sample is introduced to the FID on the OVA, its response is not as linear as laboratory-type instruments for analyzing hydrocarbon mixtures. The air flow rate, meter temperature and pressure, enclosure inlet and outlet pollutant concentration, and the rescreening data were recorded on keypunch coding sheets. An example of the data sheet is included in Appendix D.

3.5 QUALITY CONTROL

Quality control was an integral part of all data acquisition activities. The primary areas involving quality control activities were:

- instrument calibration,
- repeat screening,
- rescreening before and after sampling,
- testing for statification and leaks in source enclosures,
- flow rate variation, and
- repeat sampling.

The OVA-108 detectors were calibrated each day before the beginning of testing. Methane in air standards were used for calibration at 4500 ppm and 2015 ppm. The dilution probe factor was set at 10/1 during the calibration procedure. The calibration was spot-checked at midday to detect any serious malfunction. The calibration gases were sampled at the end of each day's testing and the values observed were recorded.

Several specific valves were screened every day by each screening team. These data were collected in order to document variability due to different screening personnel, instruments, and/or changes in the leak itself.

The effects of any variability were minimized by re-screening all sampled sources immediately before and after sampling. The average of the two screenings was used in the development of the correlation between leak rates and screening values.

Accurate measurement of leak rates required that equilibrium be achieved in the enclosed leak control volume. The enclosure was tested for tightness of seal throughout the sampling duration by using the OVA to traverse the edges of the enclosure. The tendency for stratification was minimized by constructing the enclosure such that the inlet air was directed at the point of maximum leakage to induce mixing. The enclosure outlet was also positioned to provide for good mixing in the enclosure. The OVA was used to sample the concentration within the enclosure at various places by punching small holes in the enclosure. These holes were resealed with tape after testing for stratification.

Several sources were sampled at three different air flow rates. This procedure provided information to document the variability of calculated leak rates attributable to sampling at different dilution rates. Repeat sampling was also performed on two sources. These two sources were sampled twice on different days in order to document changes due to changes in the source itself.

SECTION 4.0
TEST RESULTS

The results of the Kosovo fugitive emissions testing are presented in this section. This presentation addresses the following areas:

- emission source population,
- source screening results,
- leak rate measurement results,
- emissions estimation, and
- other emission sources.

The emission source populations show the distribution of various types of fugitive emission sources (gas valves, liquid flanges, etc.) in the process units. These populations can be used with emission factors to estimate total emissions from each process unit.

The results of the source screening can be illustrated by preparing a leak frequency distribution plot. These plots show the percent of sources screened that have screening values greater than any selected value. These plots are useful for identifying the sources or process units that have the majority of the larger leaks.

The data for the emission rate measurements were combined with the screening data in order to develop correlations between screening values and leak rates. These correlations were used to estimate emission rates from sources that were screened, but were not sampled. These emissions estimates were then used to calculate emission factors for several source categories. The emission factors and source populations were then used to calculate a total emission estimate for each process unit.

In the section on other emission sources, several potential fugitive emission sources are identified. Although no quantitative emission data were obtained, the qualitative observations that indicate emission potential are detailed.

4.1 DEVELOPMENT OF STREAM GROUPS

Seventeen different types of stream name codes were used to identify process streams during the testing. Within each of the stream names, the actual composition of a stream with that name could change many times throughout the process. If a different name was assigned each time a slight composition change occurred, the list of stream names would be very long. Although this approach would appear to be quite detailed, several practical considerations precluded its use. As the number of subcategories increases, the number of data points in each subcategory decreases. If a subcategory has very few data points, the confidence intervals associated with results pertaining to that subcategory will be very large. A point of diminishing returns is reached when the results obtained by dividing a category of data are less useful than the original results. A large number of stream designations would also greatly increase the time needed for the initial survey to identify process lines and would require placement of stream identification tags at every process junction where the composition (and stream name) changed. The approach that was selected was to assign a stream name to each of the major types of process streams, and to assign a new name only if a major composition change occurred.

The preliminary analysis of the data was performed with each of the stream names treated as a separate category. Several of the streams showed similar leak frequency distributions, and development of stream groups was investigated. Previous studies have shown that vapor pressure is an important variable and, therefore, the first grouping considered was related to vapor pressure. The three categories developed were: 1) gas streams, 2) hydrocarbon liquids, and 3) aqueous liquids. The gas streams were further separated into clean gas and raw gas, and the hydrocarbon liquids were separated into methanol and other hydrocarbon liquids. The results of the source screening (leak frequency plots) are shown in Section 4.3 for all subgroupings.

4.2 EMISSION SOURCE POPULATIONS

The types of fugitive emission sources identified in the five Kosovo process units which were addressed in this study are shown in Table 4-1. These source populations were determined by counting the sources in the process units after the process lines were painted to identify gas and liquid services. In the gasification unit, the source counts are based on two of six gasifiers and in the gas cooling unit, the counts are based on two of three cooling trains. The sources shown as inaccessible include those that would require ladders, scaffolding, or other special equipment in order to be screened.

TABLE 4-1. POPULATION OF FUGITIVE EMISSION SOURCES IN KOSOVO PROCESS UNITS

Process Unit	Source Type Valves Gas	 Hydrocarbon Liquids	 Aqueous	 Flanges Gas	 Hydrocarbon Liquids	 Aqueous	 Pumps Hydrocarbon Liquids	 Aqueous	 Open-Ended Lines Gas	 Liquids
Gasification (2 of 6 gasifiers)										
Inaccessible	13	-	0	191	-	145	-	0	ND	ND
Accessible	86	-	140	164	-	128	-	6	8	10
Total	99	0	140	355	0	273	0	6	-	-
Rectisol										
Inaccessible	26	75	11	162	574	82	0	0	ND	ND
Accessible	143	469	67	396	885	126	33	2	4	52
Total	169	544	78	558	1459	208	33	2	-	-
Phenosolvan										
Inaccessible	18	14	25	89	217	402	0	0	ND	ND
Accessible	19	98	184	44	277	514	8	7	0	48
Total	37	112	209	133	494	916	8	7	-	-
Gas Cooling (2 of 3 cooling trains)										
Inaccessible	15	4	-	93	222	-	-	-	ND	ND
Accessible	70	64	-	170	70	-	-	-	2	6
Total	85	68	0	263	292	0	0	0	-	-
Tar Separation										
Inaccessible	0	8	3	73	183	58	0	0	ND	ND
Accessible	33	168	53	78	341	107	6	8	4	18
Total	33	176	56	151	524	165	6	8	-	-
TOTAL										
Inaccessible	72	101	39	608	1196	687	0	0	ND	ND
Accessible	351	799	444	852	1573	875	47	23	18	134
Total	423	900	483	1460	2769	1562	47	23	-	-

ND = Not determined

The Rectisol unit is by far the most "complex" unit in the Kosovo gasification plant with respect to the number of valves, pumps, and flanges. It contains almost as many sources as all other process units combined.

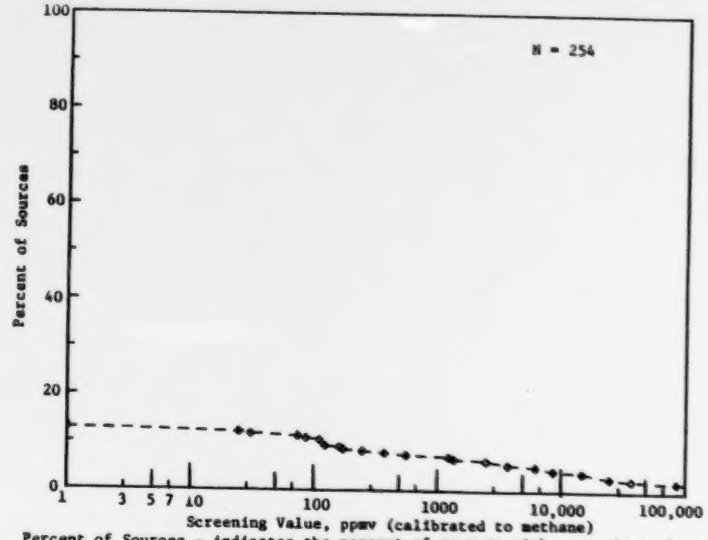
4.3 LEAK FREQUENCY

Leak frequency is defined here as the fraction of a source population that has screening values greater than a given value. The criterion for assessing leak frequency is the maximum observed screening value. As detailed in Appendix A, the screening method required a traverse of all potential leak sites with the sampling probe. The maximum concentration observed on the instrument readout was recorded as the screening value for the source. The percent of sources found with a screening value greater than any selected value is shown in Figures 4-1 through 4-12 for several groups of source type/unit/process stream combinations. In these figures, the vertical axis shows the percent of sources with screening values greater than the screening value on the horizontal axis.

In all cases, the data show that the majority of sources had a screening value of zero. Although this does not conclusively mean that no emissions were present, a source with a screening value of zero would have a very low probability of being a significant emission source. The data also show that as the screening value increases, the percent of sources included drops sharply.

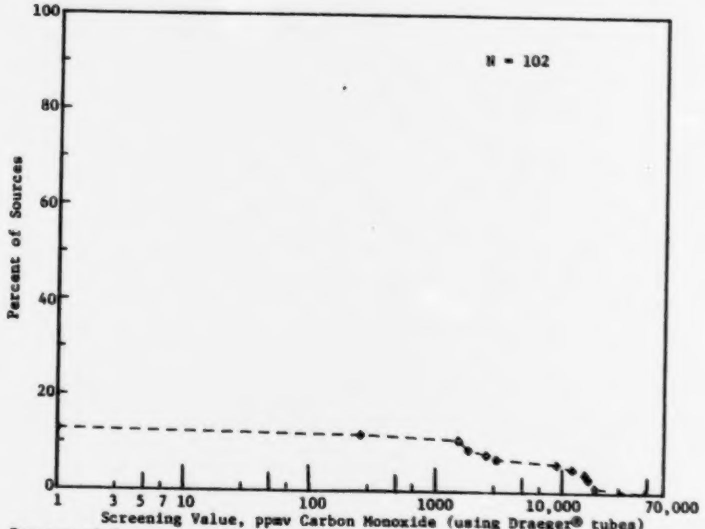
4.4 LEAK RATE/SCREENING VALUE MODELS

Statistical models were developed to fit the leak sampling data to the screening data. Each source was screened immediately before and after sampling, and the log of the average of



Percent of Sources - indicates the percent of sources with screening values greater than the selected value.

Figure 4-1. Cumulative Distribution of Sources by Screening Values for: Kosovo Valves/All Gas Streams



Percent of Sources - indicates the percent of sources with screening values greater than the selected value.

Figure 4-2. Cumulative Distribution of Sources by Screening Values for: Kosovo Valves/Carbon Monoxide

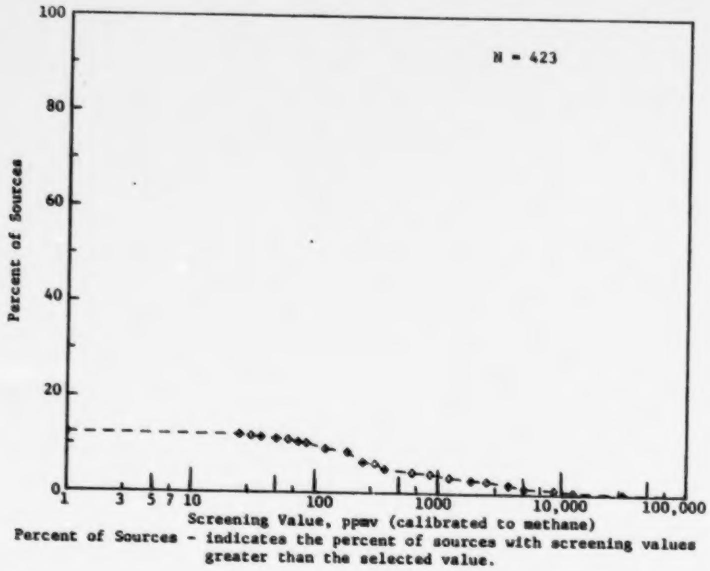


Figure 4-3. Cumulative Distribution of Sources by Screening Values for: Kosovo Valves/All Hydrocarbon Liquids

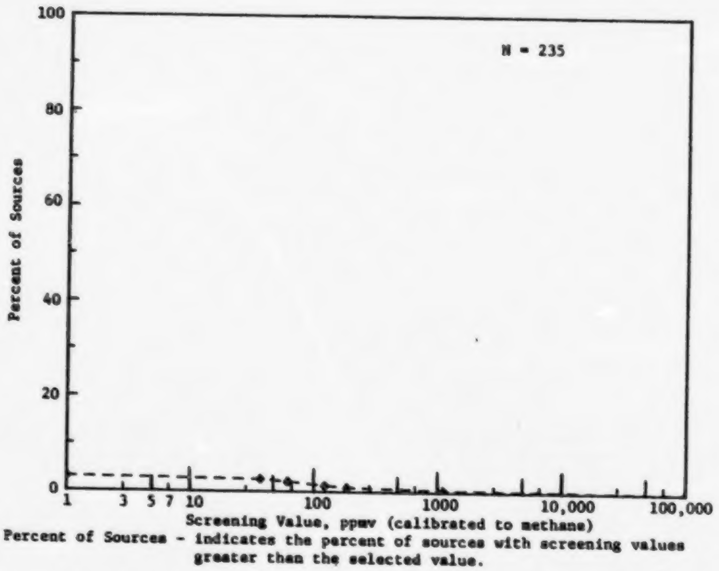
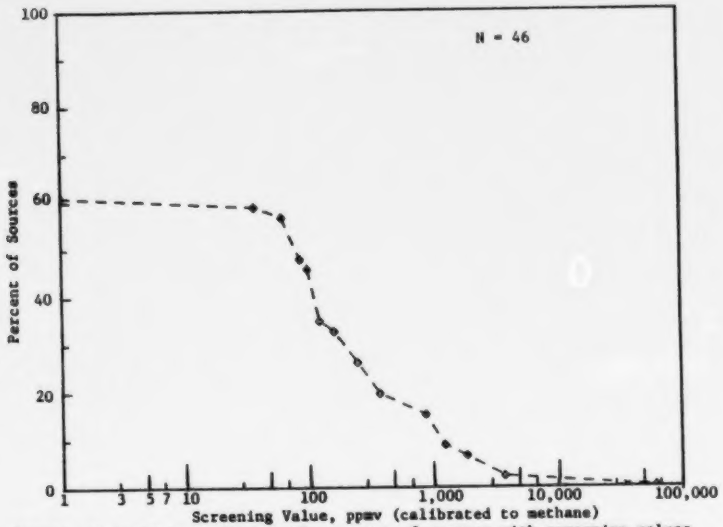
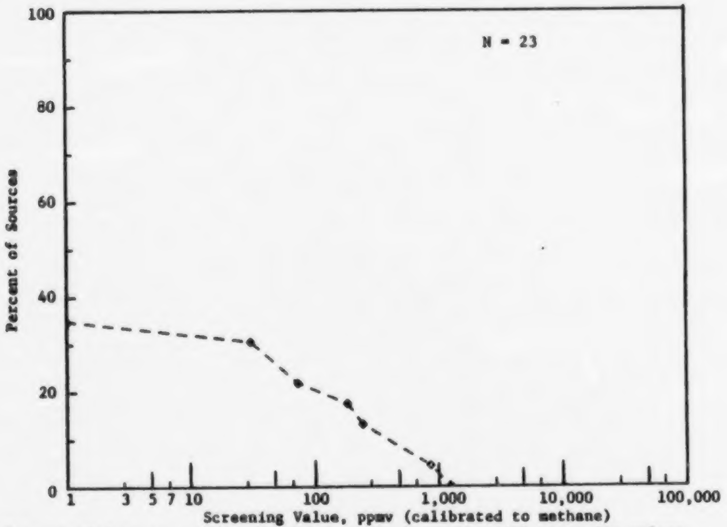


Figure 4-4. Cumulative Distribution of Sources by Screening Values for: Kosovo Valves/Aqueous Liquids



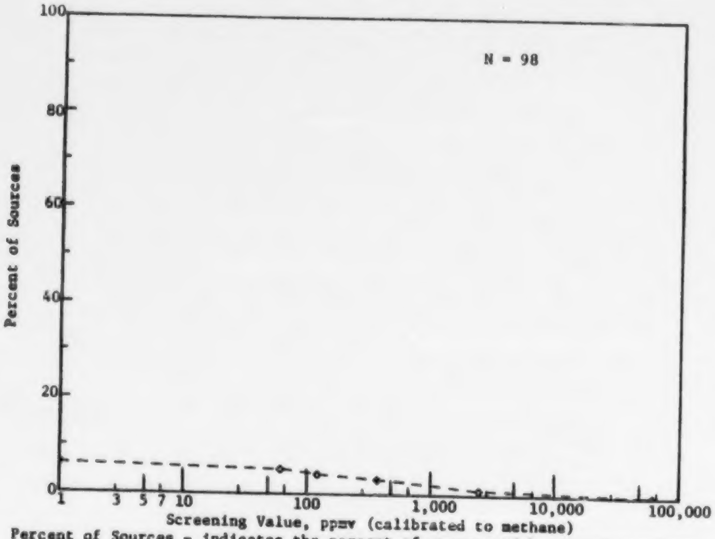
Percent of Sources - indicates the percent of sources with screening values greater than the selected value.

Figure 4-5. Cumulative Distribution of Sources by Screening Values for: Kosovo Pumps/All Hydrocarbon Liquids



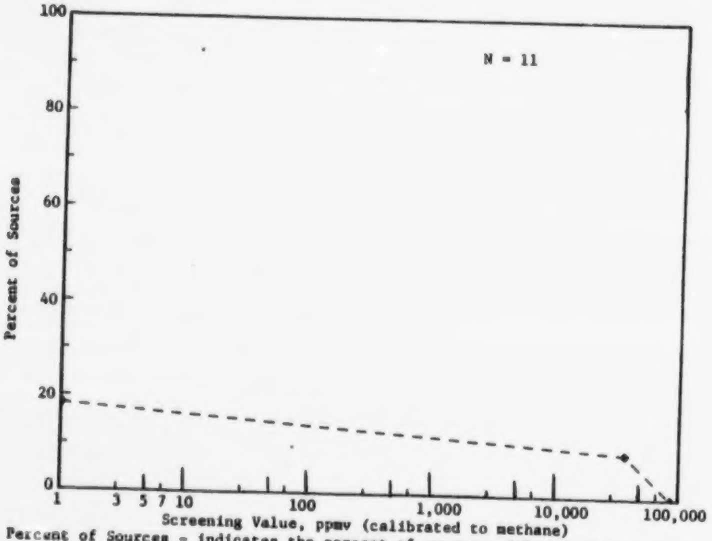
Percent of Sources - indicates the percent of sources with screening values greater than the selected value.

Figure 4-6. Cumulative Distribution of Sources by Screening Values for: Kosovo Pumps/Aqueous Liquids



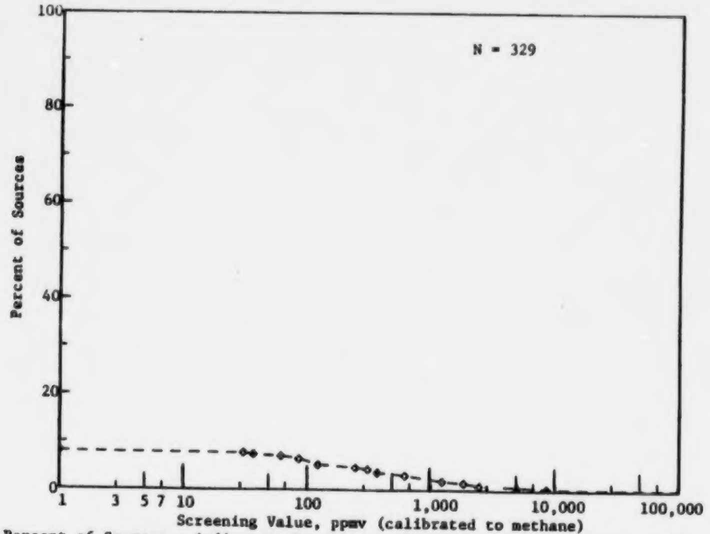
Percent of Sources - indicates the percent of sources with screening values greater than the selected value.

Figure 4-7. Cumulative Distribution of Sources by Screening Values for: Kosovo Flanges/All Gas Streams



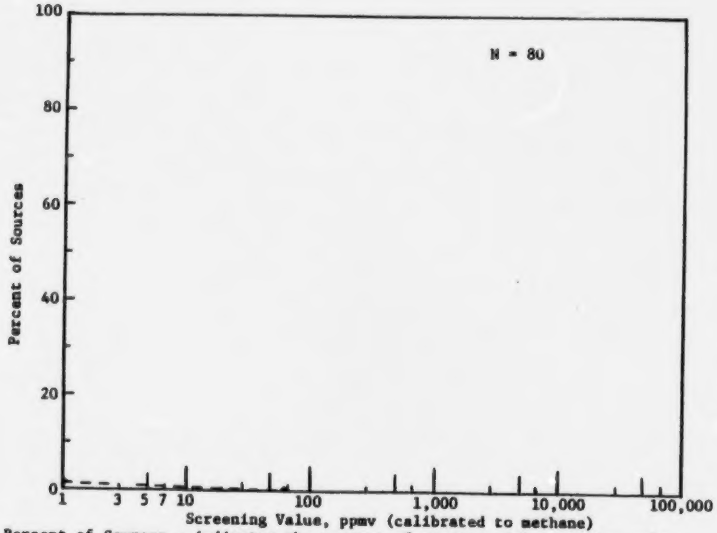
Percent of Sources - indicates the percent of sources with screening values greater than the selected value.

Figure 4-8. Cumulative Distribution of Sources by Screening Values for: Kosovo Open-Ended Lines/All Gas Streams



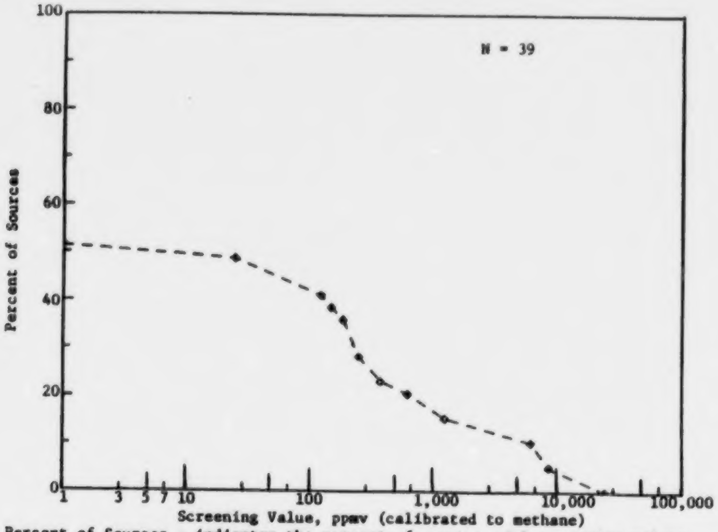
Percent of Sources - indicates the percent of sources with screening values greater than the selected value.

Figure 4-9. Cumulative Distribution of Sources by Screening Values for: Kosovo Flanges/All Hydrocarbon Liquids



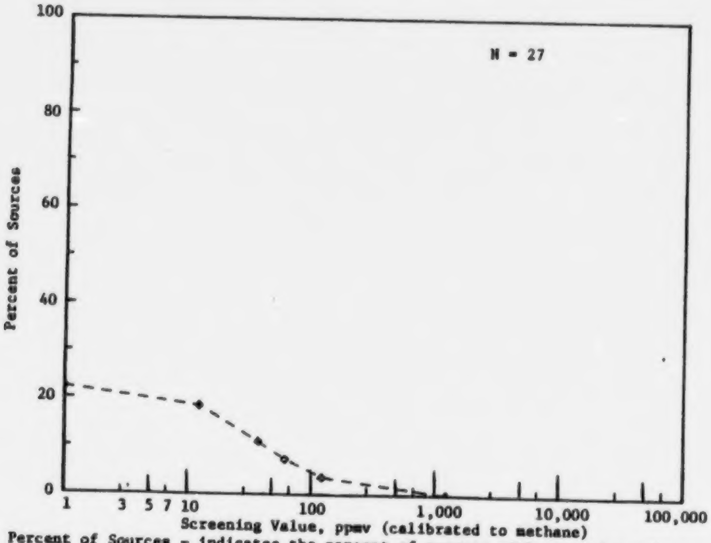
Percent of Sources - indicates the percent of sources with screening value greater than the selected value.

Figure 4-10. Cumulative Distribution of Sources by Screening Values for: Kosovo Flanges/Aqueous Liquids



Percent of Sources - indicates the percent of sources with screening values greater than the selected value.

Figure 4-11. Cumulative Distribution of Sources by Screening Values for: Kosovo Open-Ended Lines/All Hydrocarbon Liquids



Percent of Sources - indicates the percent of sources with screening values greater than the selected value.

Figure 4-12. Cumulative Distribution of Sources by Screening Values for: Kosovo Open-Ended Lines/Aqueous Liquids

these two screenings was regressed onto the log of the measured emission rate. The raw data from the screening and sampling are included in Appendix H.

As described in Section 3.0, sources were selected for sampling based on their screening values. Since the selection criteria were weighted toward higher screening values, sources in units with numerous high screening values were more likely to be selected for sampling. Because of the large number of sources and high percentage of leaks for sources in the clean gas and methanol streams, most of the sampling data are from these two streams.

Because of a shortage in di-isopropyl ether (DIPE), the Phenosolvan unit was off-line during part of the testing. All screening had been completed, and one pump was sampled at the time the DIPE supply was depleted.

In developing the models between screening values and measured emission rates, it was found that the models for valves, pumps, and flanges were not significantly different. Therefore, all source types were combined for the development of the models. However, the effect of stream service (gas, liquid) was found to be significant, and different models were developed for each service.

The model that was developed for liquid streams is shown in Figure 4-13. The dashed lines indicate the 95 percent confidence interval for the predicted mean value. At the maximum end of the screening value scale, the confidence interval spans more than an order of magnitude for the mean leak rate estimate. This confidence interval only applies to a large number of sources. It indicates that if a large number of cases are tested, we would

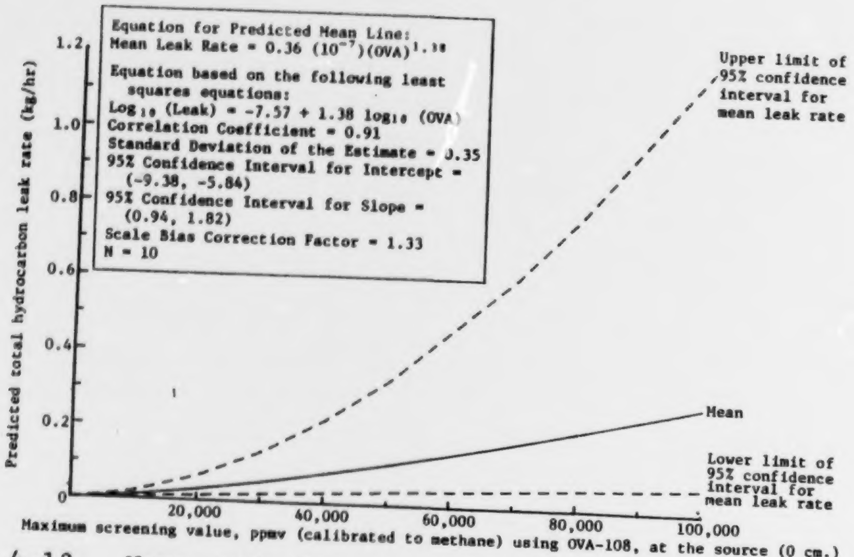


Figure 4-13. Nomograph for Predicting Total Hydrocarbon Leak Rates from Maximum Screening Values - Kosovo/ Hydrocarbon Liquid Streams

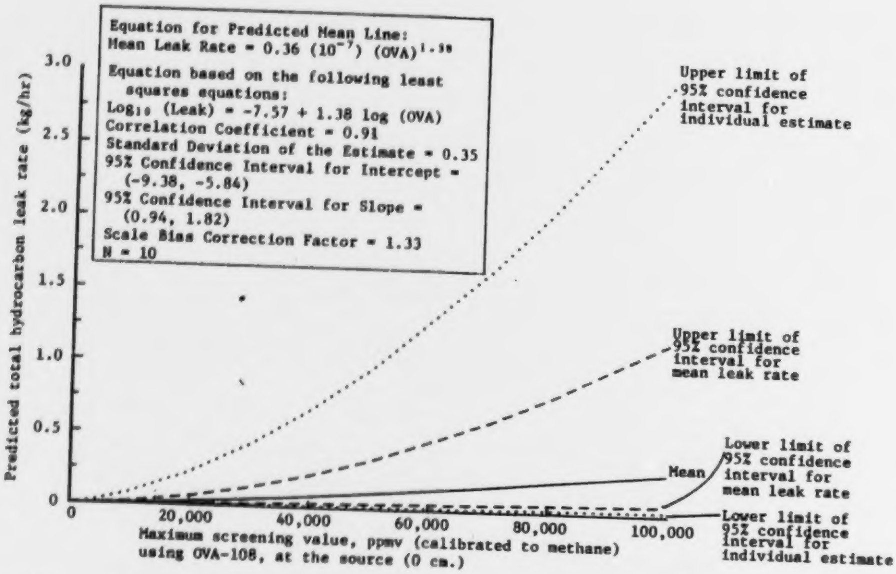


Figure 4-14. Nomograph for Predicting Total Hydrocarbon Leak Rates from Maximum Screening Values - Kosovo/ Hydrocarbon Liquid Streams (Confidence Intervals Shown for Mean and Individual Values)

expect the mean value to fall within the confidence interval 95 percent of the time. The confidence interval for a single estimate is much wider. In Figure 4-14, the same liquid service model is shown with the confidence interval for a single estimate indicated by dotted lines. (Note the y axis scale change.)

For gas streams, two models were developed. One model is for hydrocarbon emission rates related to OVA screening values and the other model is for CO emission rates related to Draeger® tube screening values. The models for gas streams are shown in Figures 4-15 and 4-16. The 95 percent confidence intervals for the predicted mean value are indicated by dashed lines.

4.5 EMISSIONS ESTIMATION

In order to estimate total emission rates from each process unit, it is necessary to know the population of sources and the average emission rate of each source. The population of each type of emission source was given in Table 4-1. As described in Section 4.1, stream subgroups were developed in order to identify correlating variables with significant differences.

These subgroups can be useful for evaluation of leak frequencies for different process combinations, but they were not selected as the basis for emission factor development. These decisions were based on the fact that a leak frequency plot is simply a graphic example of the data collected, but development of emission factors involves use of a correlation to estimate leak rates. The smaller populations in the subcategories resulted in unacceptably large confidence intervals for the emission factor estimates. Emission factors for the major stream groups were developed, but certain precautions should be observed before applying these emission factors:

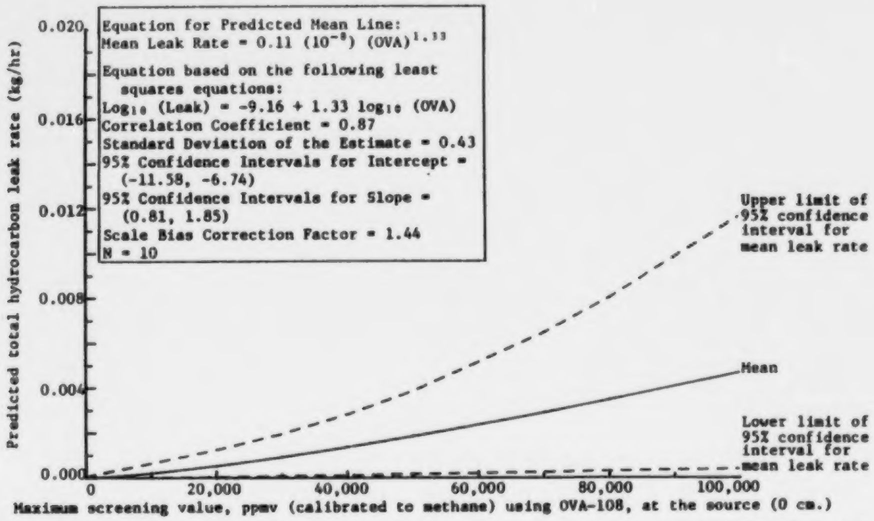


Figure 4-15. Nomograph for Predicting Total Hydrocarbon Leak Rates from Maximum Screening Values - Kosovo/Gas Streams

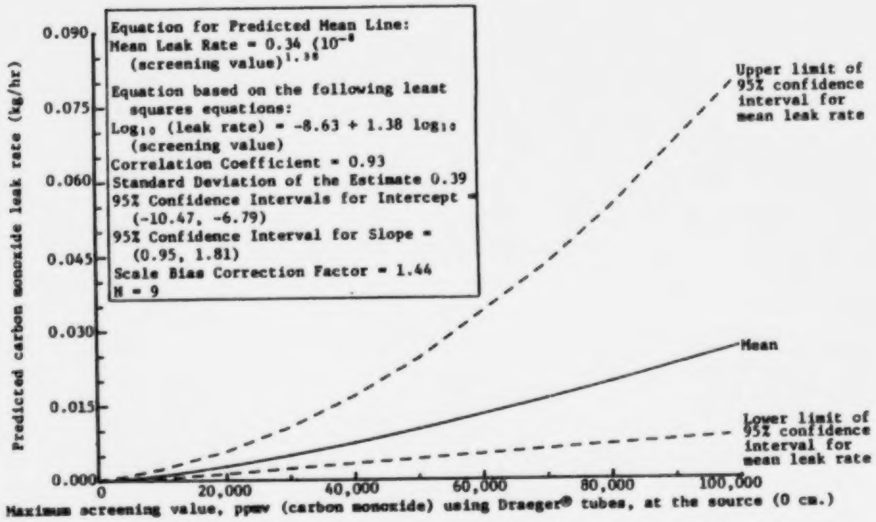


Figure 4-16. Nomograph for Predicting Carbon Monoxide Leak Rates from Maximum Screening Values - Kosovo/Carbon Monoxide Streams

- Because of the small number of sources sampled (27), confidence intervals for the estimated emission factors are very large and may include zero. Furthermore, these confidence intervals only indicate how well the emission factors represent the true emission factor for Kosovo sources.

- Emission factors are shown for aqueous service sources based on the model developed for hydrocarbon liquids, because no aqueous service sources were sampled. The sampling selection criteria were weighted toward sources with higher screening values, and as shown in Figures 4-4, 4-6, and 4-10, aqueous service sources had very low screening values.

- Emission factors for open-ended lines were not developed because time constraints precluded sampling of these sources. This is not a serious data gap because simple, effective controls are being applied to these sources in U.S. refineries and chemical plants, and these controls will probably be applied in coal gasification plants also.

The emission factor estimate was calculated by combining the leak frequency and leak rate/screening value model data. The leak/screening model was used to assign leak rates to sources which were not sampled based on their screening value. The distribution of screening values from the leak frequency plot was then applied to calculate the number of sources leaking at a given rate. Therefore, the overall emission factor estimate is not solely based on leak sampling data, but also includes leak estimation from the leak/screening model. These emission factors and their 95 percent confidence intervals are shown in Table 4-2 and in Figure 4-17.

Based on the emission factors and populations given above, total fugitive emissions for each process unit are given in Table 4-3. These emission estimates do not include emissions from open-ended lines, relief valves, sampling purges, and wastewater systems.

The fugitive emission rates of minor components (H_2S, NH_3, HCN, etc.) could not be determined from the available data. Although these components were detected in many of the samples, their concentrations in the samples (which were diluted with air) were often too low to be measured reliably by Draeger® tubes. Also, the available process stream data (References 1 and 2) generally covered only the major or discharge streams, so the process stream concentration at the various sampling and screening locations was often not known.

These two limitations prevented determining if the concentration ratios (HC/H_2S, HC/HCN, HC/NH_3, etc.) in the samples was the same as the ratios in the process stream. Even if the concentration ratios could have been confirmed to be the same, the limited amount of process data on internal streams would have prevented estimating minor component fugitive emission rates using the hydrocarbon fugitive emissions data and the process concentration ratios (e.g., if the H_2S concentration is one-half the measured HC fugitive emission rate, then the estimated H_2S fugitive emission rate is one-half of the measured HC fugitive emission rate).

TABLE 4-2. ESTIMATED EMISSION FACTORS

Source Category	Emission Factor Estimate[1] (kg/day-source)	95% Confidence Interval for Emission Factor (kg/day-source)
Valves		
Gas	0.0019	(0.0002, 0.016)
HC Liquid	0.0026	(0.0008, 0.01)
Aqueous	0.0012	(Neg., 0.12)
Pumps		
HC Liquid	0.0050	(0.0009, 0.03)
Aqueous	0.00120	(Neg., 0.021)
Flanges		
Gas	0.00024	(Neg., 0.01)
HC Liquid	0.00048	(Neg., 0.02)
Aqueous	Neg.	(Neg., 0.0004)

Neg. = Negligible (<3 x 10^{-5} kg/day)

[1] Emission factor represents only gaseous leaks. Liquid drops are not included.

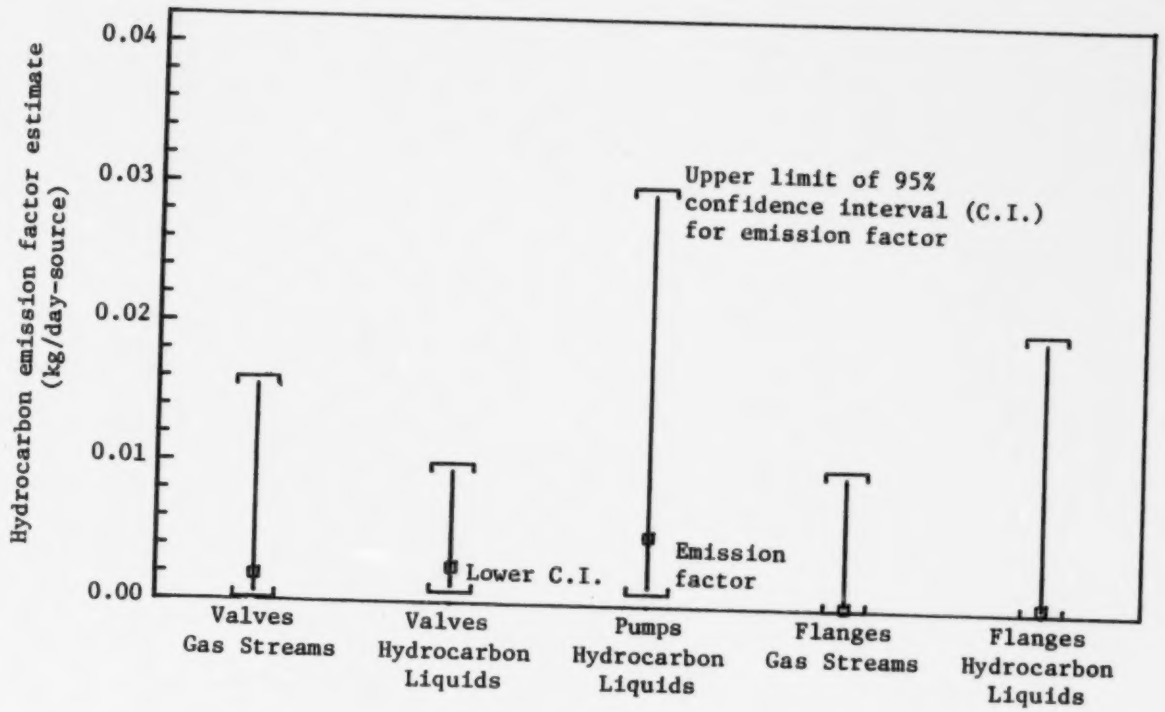


Figure 4-17. Estimated Hydrocarbon Emission Factors for Kosovo Sources

TABLE 4-3. TOTAL EMISSION RATES (KG/DAY) FROM KOSOVO FUGITIVE EMISSION SOURCES

Source Type/Service (Emission Factor - kg/day source)	Process Unit											
	Rectisol		Phenosolvan		Tar Separation		Gas Cooling		Gasification		Total	
	Number Sources	Emissions	Number Sources	Emissions	Number Sources	Emissions	Number Sources[a]	Emissions	Number Sources[a]	Emissions	Number Sources	Emissions[b]
Hydrocarbon Emissions												
Valves/gas (0.0019)	169	0.32	37	0.07	33	0.06	85	0.16	99	0.19	423	0.80
Valves/hydrocarbon liquid (0.0026)	544	1.41	112	0.29	176	0.46	68	0.18	0	0	900	2.34
Valves/aqueous (0.0012)	78	0.09	209	0.25	56	0.07	0	0	140	0.17	483	0.58
Flanges/gas (0.00024)	558	0.13	133	0.03	151	0.04	263	0.06	355	0.09	1460	0.35
Flanges/hydrocarbon liquid (0.00048)	1459	0.70	494	0.24	524	0.25	292	0.14	0	0	2769	1.33
Flanges/aqueous ($< 3 \times 10^{-5}$)	208	<0.006	916	<0.03	165	<0.005	0	0	273	<0.008	1562	<0.05
Pumps/hydrocarbon liquid (0.005)	33	0.17	8	0.04	6	0.03	0	0	0	0	47	0.24
Pumps/aqueous (0.0012)	2	<0.003	7	0.01	8	0.04	0	0	6	0.01	23	0.03
TOTAL	-	2.83	-	0.96	-	0.92	-	0.54	-	0.46	-	5.72
Carbon Monoxide Emissions												
Valves/gas (0.0012)	169	0.20	37	0.04	33	0.04	85	0.10	99	0.12	423	0.51

[a] Gasification and gas cooling emissions estimates are based on two of six gasifiers (and two of three cooling trains) in operation. Coal feed rate is approximately 30 metric tons per hour with two gasifiers running.

[b] Does not include emissions from open-ended lines, sampling purges, or wastewater systems.

A limited number of concentration ratio comparisons was possible from the data. These comparisons are shown in Appendix G. These comparisons indicate that for desulfurized medium-Btu gas, the ratio of the hydrocarbon concentration to the carbon monoxide concentration does not vary between the process stream and the fugitive emission sample. Other conclusions cannot be drawn due to the limitations discussed earlier.

Liquid leaks are a potential source of fugitive emissions if the liquid is not collected and routed to an enclosed treatment and/or recovery system. At the Kosovo plant some liquid leaks merely fell onto the pavement and became part of the surface runoff, while other liquid leaks were collected and run into a drain. As is discussed in Section 4.6, the drain system may be a significant source of fugitives. Since these liquid leak control techniques are not felt to be representative of U.S. plants, the potential vapors from these liquid leaks were not included in the calculated emission factors calculated. This is consistent with the way emission factors have been calculated on other studies, where it is assumed that if the emission does not vaporize at ambient conditions, it is not an air emission at that point.

The number of liquid leaks observed and the percentage of each source which was found to be leaking are shown in Table 4-4. In this table, a liquid leak is defined as any visible organic liquids dripping from the source.

4.6 OTHER EMISSION SOURCES

In addition to the results presented above, several qualitative observations were made during the testing. These observations generally pertain to additional sources of

TABLE 4-4. FREQUENCY OF LIQUID LEAKS

Source Type	Stream Type Aqueous	 All Other Liquids
Valves		
Number leaking	9	11
Percent leaking	3.8	1.7
Pumps		
Number leaking	13	12
Percent leaking	56	26
Flanges		
Number leaking	4	2
Percent leaking	4.9	1.1
Open-Ended Lines		
Number leaking	2	7
Percent leaking	7.4	14.3

significant fugitive emissions such as sampling operations, wastewater systems, and equipment cleaning procedures.

Most of the sample purge operations observed resulted in atmospheric emission of the entire purge. Liquid purges were drained onto the ground or into an open drain system where eventual evaporation would result. Most of the process drainage collection and transport systems at Kosovo are covered by loose fitting concrete slabs. The residence time in many of these collecting canals appears to be long and, therefore, the potential for significant atmospheric emissions exists.

Equipment cleaning activities can also be a potential emission source. In many cases, vessels and exchangers were prepared for cleaning by emptying the contents onto the ground. The volatile fractions become atmospheric emissions very quickly but the heavy residue presents another potential problem. Work activities in these spill areas can result in aerosol emissions of the heavy residue or direct worker contact with the residue. These emissions are not included in the emission factors developed during this study.

SECTION 5.0
CONCLUSIONS AND RECOMMENDATIONS

The major conclusions drawn from the test results pertain to:

- applicability and limitations of test results
- comparison of test results to other fugitive emission test data, and
- relative significance of fugitive emissions at the Kosovo plant.

Recommendations are presented in Section 5.4, following the discussion of conclusions. The recommendations are based on the conclusions drawn from the test data and pertain to:

- additional data requirements,
- methodology improvements, and
- control technology considerations.

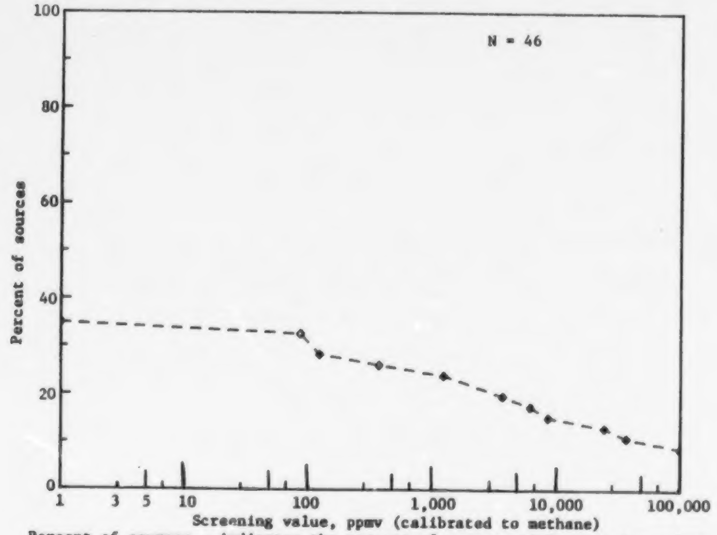
5.1 APPLICABILITY AND LIMITATIONS OF RESULTS

In this section, the limitations that must be acknowledged when applying the results of the Kosovo fugitive emission testing are discussed. The discussion includes examples of how the data can be used, examples of what the data do not include, and examples of what factors to consider when attempting to apply the data to estimate parameters not specifically included in the data base.

5.1.1 Leak Frequency

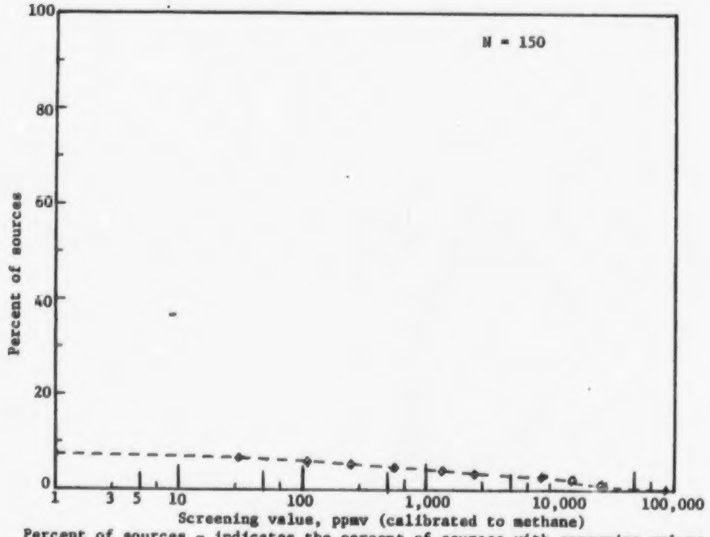
The plots of frequency of leak occurrence (indicated by screening values) shown in Figures 4-1 through 4-12 are a graphical presentation of the actual data collected. For each source type and process stream combination, the plots show the percent of sources that had a screening value greater than the selected value on the horizontal axis. Although these plots may or may not be indicative of leak frequencies at plants other than Kosovo, they do provide useful information. For example, the emission factors for gas valves (0.0019) and hydrocarbon liquid valves (0.0026) are only 25 percent different from each other (see Table 4-2). However, Figures 4-1 and 4-3 show a difference in the leak frequency of these two sources. The gas valves have about the same proportion of nonleaking (0 ppm) sources with 13 percent versus 12 percent for liquid valves. However, gas valves have a much larger proportion of very large leaks (>100,000 ppm), with 5 percent versus 1 percent for liquid valves.

The leak frequency plots for some of the stream subgroups are shown in Figures 5-1 through 5-6. These figures indicate that certain stream subgroups are more likely to have significant leaks. For example, valves on the clean gas streams (Figure 5-1) have approximately 10 percent of the sources with screening values greater than 100,000 ppmv, while the raw gas streams (Figure 5-2) have fewer than 10 percent of the sources with screening values greater than zero. This difference could be the result of raw gas contaminants (probably tars) which may effectively seal many leaks. Also, pumps and valves on methanol streams (Figures 5-3, 5-5) have more leaks than the same sources on other hydrocarbon streams (Figures 5-4, 5-6). A "plugging" (by contaminants) mechanism may explain this observation also.



Percent of sources - indicates the percent of sources with screening values greater than the selected value

Figure 5-1. Kosovo Valves/Clean Gas Streams



Percent of sources - indicates the percent of sources with screening values greater than the selected value.

Figure 5-2. Kosovo Valves/Raw Gas Streams

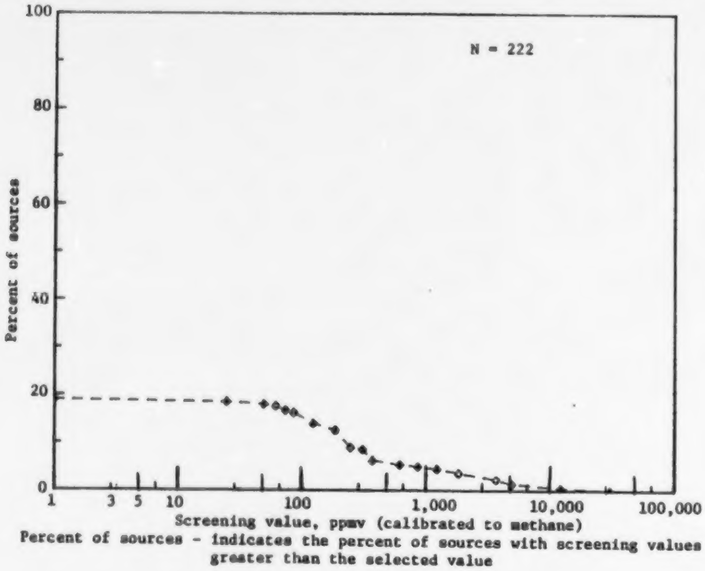


Figure 5-3. Kosovo Valves/Methanol Streams

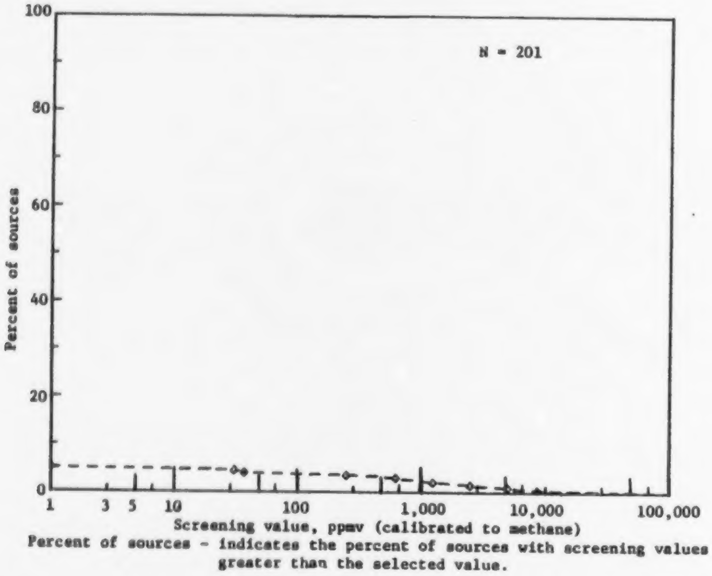
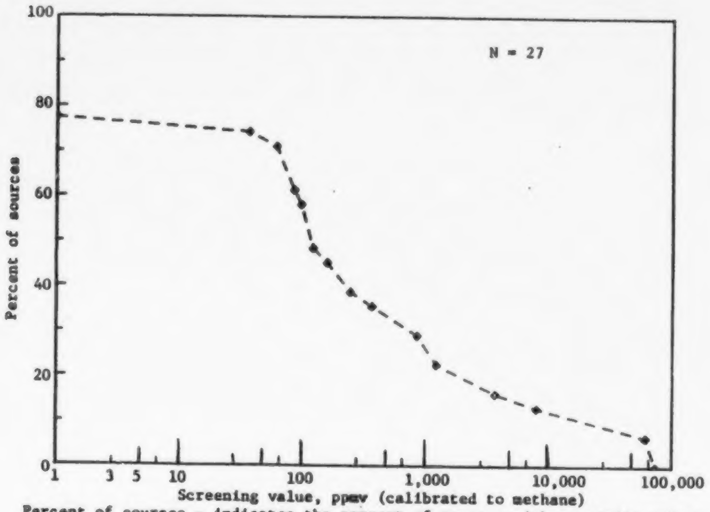
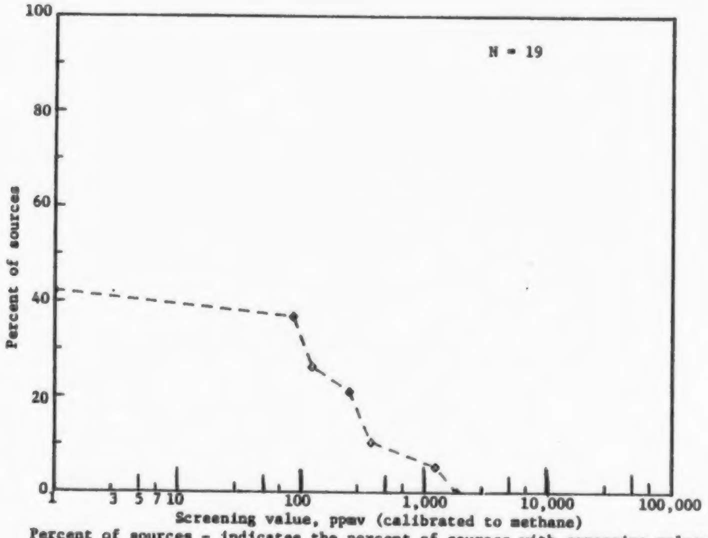


Figure 5-4. Kosovo Valves/Other Hydrocarbon Liquids



Percent of sources - indicates the percent of sources with screening values greater than the selected value.

Figure 5-5. Kosovo Pumps/Methanol Streams



Percent of sources - indicates the percent of sources with screening values greater than the selected value

Figure 5-6. Kosovo Pumps/Other Hydrocarbon Liquids

Assessment of leak frequency data will identify areas that tend to have more large leaks. Leak repair experience in U.S. refineries has shown that the repair effectiveness decreases as the initial leak rate of the source decreases. This is due to the fact that in some cases, attempting repair may actually increase the emission rate from the source. If the initial emission rates are low, an emission increase from one source can easily negate the emission reduction achieved by repairing many other sources. Large leaks are also more cost effective to repair because repair costs are proportional to the number of repairs performed.

The leak frequency data from this study show which sources and streams have large leaks at Kosovo. Other plants may have significantly different frequencies of leaks, but the relative magnitude of leak frequencies for source/stream combinations should be similar. It is reasonable to expect that gas service valves will have a higher leak frequency than aqueous service valves, regardless of the magnitude of the numerical values.

5.1.2 Emission Factors

Models were developed to relate screening values to measured emission rates. In order to get the best statistical fit of the data, several combinations of variables were investigated. The type of source (valve, pump, flange) did not show a significant effect upon leak rate/screening value models. The type of process fluid was the most significant correlating variable found. Therefore, all source types were used in developing these relationships. In refinery fugitive emissions testing (Reference 3), source type was found to have a minor effect on the leak rate/screening value models. There was, however, a much larger data base in the refinery fugitive emissions testing program.

As described in Section 4.5, emission factors were not developed for stream subcategories. This was primarily because models were only developed for the two major service categories - gas and hydrocarbon liquids. The emission factors for aqueous service streams are based on the model for hydrocarbon liquids combined with the test data for leak frequency of aqueous streams. An additional model was developed to relate the emission rate of CO to the Draeger® tube screening value for CO. This model was used in developing the CO emission factors for gas service sources.

The limitations of the emission factors presented in Tables 4-2 and 5-1 must be considered, especially when using the emission factors for any facility other than the Kosovo plant. The 95 percent confidence intervals associated with each emission factor span two to four orders of magnitude around the mean value. These confidence intervals are large because the number of sources sampled was small and therefore, the modeled relationship between screening values and emission rates is imprecise. Users of the emission factors should be aware that the confidence intervals reflect how well the estimated emission factors represent the true measured emissions in the Kosovo plant, and do not necessarily provide any indication of the true emissions at other plants.

If the Kosovo emission factors are used to estimate emissions at other plants, it is important to apply the correct emission factor for stream service. Gas service and aqueous service are not ambiguous, but the emission factor for hydrocarbon liquids should be used with caution. This emission factor applies to the overall source/stream distribution at Kosovo, but individual stream emission factors can be expected to vary widely. For example, the emission factors for methanol and naphtha streams are probably larger than the factors for tars

TABLE 5-1. TOTAL EMISSION RATES FROM KOSOVO FUGITIVE EMISSION SOURCES

Source Type/Service (Emission Factor - kg/day source)	Process Unit											
	Rectisol		Phenosolvan		Tar Separation		Gas Cooling		Gasification		Total	
	Number Sources	Emissions	Number Sources	Emissions	Number Sources	Emissions	Number Sources[a]	Emissions	Number Sources[a]	Emissions	Number Sources	Emissions[b]
Hydrocarbon Emissions												
Valves/gas (0.0019)	169	0.32	37	0.07	33	0.06	85	0.16	99	0.19	423	0.80
Valves/hydrocarbon liquid (0.0026)	544	1.41	112	0.29	176	0.46	68	0.18	0	0	900	2.34
Valves/aqueous (0.0012)	78	0.09	209	0.25	56	0.07	0	0	140	0.17	483	0.58
Flanges/gas (0.00024)	558	0.13	133	0.03	151	0.04	263	0.06	355	0.09	1460	0.35
Flanges/hydrocarbon liquid (0.00048)	1459	0.70	494	0.24	524	0.25	292	0.14	0	0	2769	1.33
Flanges/aqueous ($< 3 \times 10^{-5}$)	208	<0.006	916	<0.03	165	<0.005	0	0	273	<0.008	1562	<0.05
Pumps/hydrocarbon liquid (0.005)	33	0.17	8	0.04	6	0.03	0	0	0	0	47	0.24
Pumps/aqueous (0.0012)	2	<0.003	7	0.01	8	0.04	0	0	6	0.01	23	0.03
TOTAL	-	2.83	-	0.96	-	0.92	-	0.54	-	0.46	-	5.72
Carbon Monoxide Emissions												
Valves/gas (0.0012)	169	0.20	37	0.04	33	0.04	85	0.10	99	0.12	423	0.51

[a] Gasification and gas cooling emissions estimates are based on two of six gasifiers (and two of three cooling trains) in operation. Coal feed rate is approximately 30 metric tons per hour with two gasifiers running.

[b] Does not include emissions from open-ended lines, sampling purges, or wastewater systems.

and oils, but all of these streams are included in the Kosovo emission factors for hydrocarbon liquids. Emission factors for individual streams were not developed because the small number of sources in a subdivided stream category would have resulted in very large confidence intervals for the estimated emission factor.

The total hydrocarbon emission rates from the Kosovo process units were shown in Table 4-3 and are shown again in Table 5-1. The process units are listed in decreasing order of total emissions, with Rectisol contributing 2.83 kg/day and Gasification contributing 0.46 kg/day. In the Rectisol unit, approximately one-half of the total emissions come from valves in liquid hydrocarbon service. This type of information is useful for developing control strategies, because it identifies the areas where control will provide the greatest benefit.

This information also provides a method to assess the cost effectiveness of control strategies. For example, the source types that contribute the most emissions are valves in hydrocarbon service (2.34 kg/day), followed by flanges in hydrocarbon service (1.33 kg/day). Because typical fugitive emission control strategies consist of leak detection and leak repair practices, the cost of these strategies is directly proportional to the number of sources inspected and the number of sources repaired. In the above example, 2.34 kg/day came from 900 sources, while 1.33 kg/day came from 2769 sources. The two source types with the next highest emission rates are gas valves (0.804 kg/day) and aqueous valves (0.58 kg/day). These two source types combined emit 1.38 kg/day of vapors from 906 sources. It would be more cost effective to control 1.38 kg/day from 906 sources than to control 1.33 kg/day from 2769 sources. Other factors could, however, affect the leak repair strategy. For example, a leak which introduced carbon monoxide into an enclosed work area would receive high priority regardless of other factors.

The overall process unit emission rates shown in Table 5-1 are also specific to the Kosovo plant (even if the individual source emission factors were universally applicable). This is because other process units could have a different distribution of source/service combinations. An appropriate way to use these emission factor data for other plants is to determine the number of sources in each category (e.g., valve/gas), and then multiply by the emission factor from Kosovo, rather than using the process unit fugitive emission rates from Kosovo.

5.1.3 Emissions of Minor Components

As described in Section 4.4, the emission rates of minor components such as H_2S, NH_3, HCN, etc. were not measurable due to the dilution effect of the sampling apparatus. An estimate of emission rate could be made if the process stream composition is known. The ratio of the minor component to total hydrocarbons in the stream (mass basis) could then be applied to the hydrocarbon emission factor to approximate the emission rate of the minor component. This method would require knowledge of process concentrations for all applicable internal streams. These data were not available for the Kosovo plant. Also, the error associated with the process stream analysis would increase the confidence intervals associated with the approximation, in addition to the emission factor uncertainties.

5.1.4 Liquid Leaks

The emission factors shown in Table 5-1 do not include contributions from liquid leaks. There are several reasons why it was not possible to include this contribution in the emission factors. The data in Table 4-4 showed that pump seals have the highest percent of sources with liquid leaks. Furthermore, the typical liquid leak from a pump seal was much larger than the liquid leak from any other type of source. However, the physical structure of pump housings and the presence of drain lines made it difficult to accurately measure liquid leak rates.

Even if an accurate liquid leak rate measurement was made, the atmospheric emission rate associated with the liquid leak would require analysis of the volatile organic content of the liquid leak. In the case of aqueous streams, the concentration of volatile hydrocarbons in the stream must be known or assumed in order to estimate atmospheric emissions. In some cases, the liquid leaks at Kosovo were collected and removed by a drain system. The ultimate fate of the collected leaks would have been difficult to determine and was beyond the scope of this study. As noted in Section 4.5, some of the collected liquid leaks would be exposed to the atmosphere in the numerous wastewater canals and holding tanks.

Atmospheric emissions from liquid leaks were not estimated from the test data. The uncertainties described above would make any estimate subject to large potential errors. EPA's proposed New Source Performance Standards for organic chemical plants require leak repairs whenever liquid leakage is detected. Therefore, U.S. coal gasification plants may also be subject to regulations that reduce liquid leaks, and the lack of liquid leak rate data for the Kosovo plant is not a significant data gap.

5.2 COMPARISON OF TEST RESULTS TO OTHER FUGITIVE EMISSION DATA

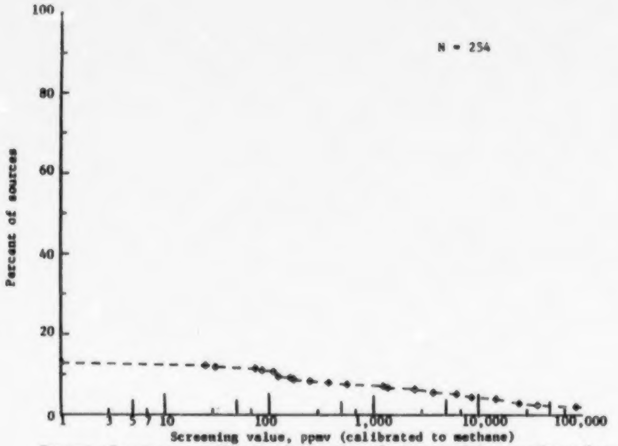
In this section, the results of the Kosovo fugitive emission testing are compared to results of similar testing conducted in U.S. petroleum refineries. The results selected for comparison include: 1) leak frequencies, 2) screening value/leak rate models, and 3) emission factors. In addition to presentation of the comparisons, each of the following sections includes a discussion of factors that could affect the comparisons.

5.2.1 Leak Frequency

Leak frequency distributions were defined and presented in Section 4.2. These plots have also been developed from test data collected in U.S. refineries. The primary similarity in all of the test results is that the majority of sources tested do not leak at all (as defined by screening values). They also show similarities with respect to the distribution of large leaks (high screening values), where the percent of sources included drops sharply as the selected screening value increases.

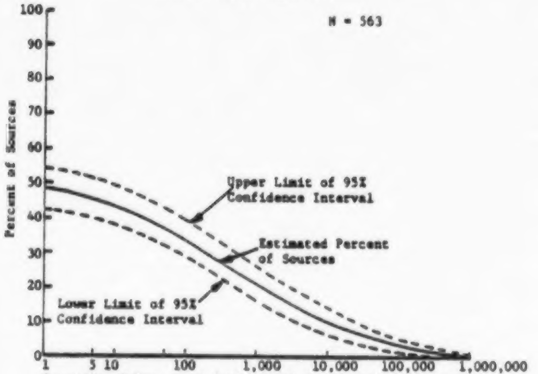
Figures 5-7 through 5-10 show the leak frequency distributions for valves, pumps, and flanges from Kosovo and refineries. There is some overlap in the definition of stream service in the three data bases. All of the gas service designations are consistent because they mean that the process fluid is in the gaseous state at the emission source. For liquids, the refinery data shown are for "light liquid" service. In refineries, this is defined as a process fluid with a vapor pressure greater than kerosene. Proposed U.S. fugitive emission regulations define light liquids as having vapor pressure greater than 0.3 kPa at 20°C (0.04 psi at 68°F).

The Kosovo data for hydrocarbon liquids include all volatilities, which range from methanol to tar liquids. However, of the hydrocarbon liquid sources screened at Kosovo, 80 to 90 percent of the sources would be classified as light liquids by the above definitions. In Table 5-2, the fraction of sources leaking for some of the Kosovo stream subgroups is shown.



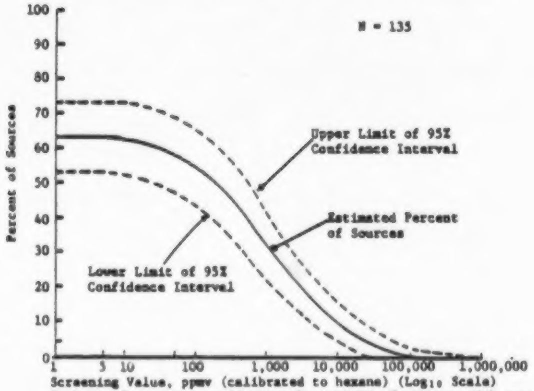
Percent of sources - indicates the percent of sources with screening values greater than the selected value.

Kosovo valves: gas streams



Percent of sources - indicates the percent of sources with screening values greater than the selected value.

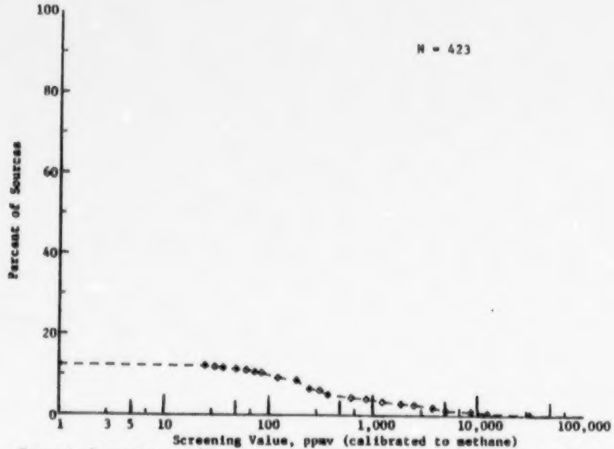
Refinery valves: gas/vapor streams (from Reference 3)



Percent of sources - indicates the percent of sources with screening values greater than the selected value.

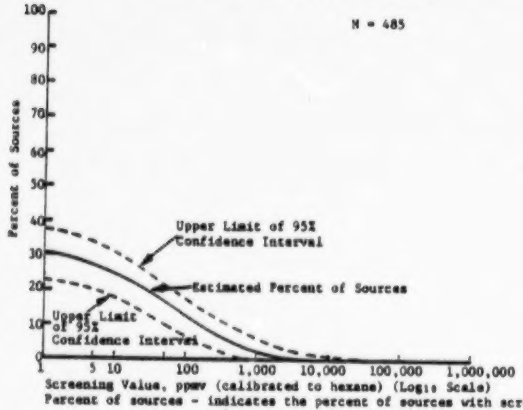
Refinery valves: hydrogen streams (from Reference 3)

Figure 5-7. Comparison of Leak Frequency for Kosovo and U.S. Refineries: Valves/Gas Streams



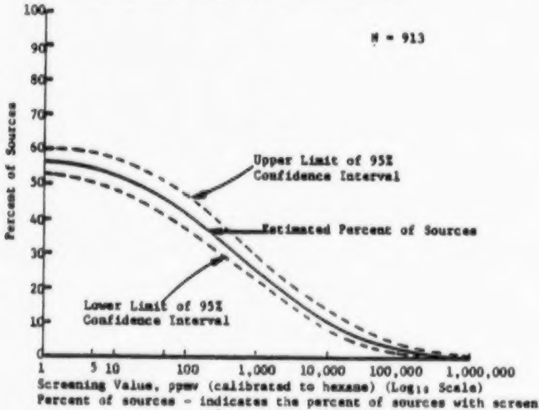
Percent of sources - indicates the percent of sources with screening values greater than the selected value.

Kosovo valves: hydrocarbon liquids



Percent of sources - indicates the percent of sources with screening values greater than the selected value.

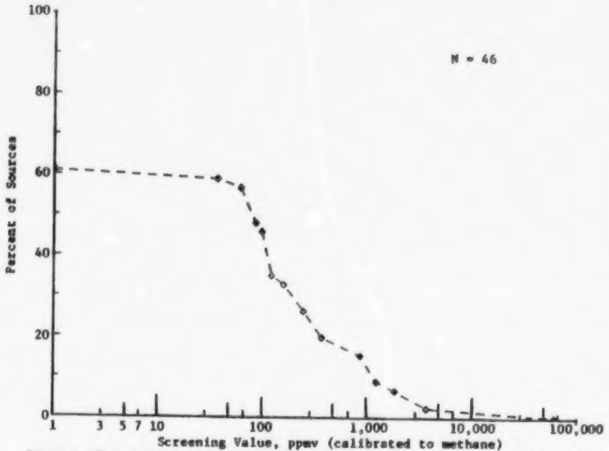
Refinery valves: heavy liquids (from Reference 3)



Percent of sources - indicates the percent of sources with screening values greater than the selected value.

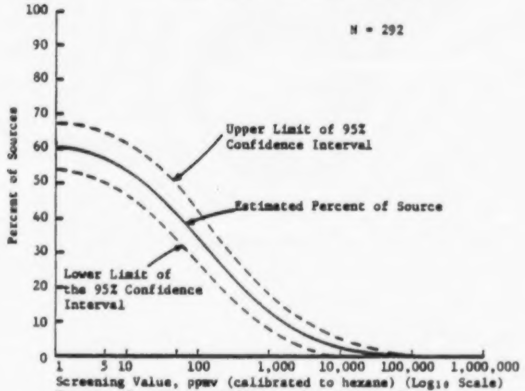
Refinery valves: light liquids (from Reference 3)

Figure 5-8. Comparison of Leak Frequency for Kosovo and U.S. Refineries: Valves/Hydrocarbon Liquids



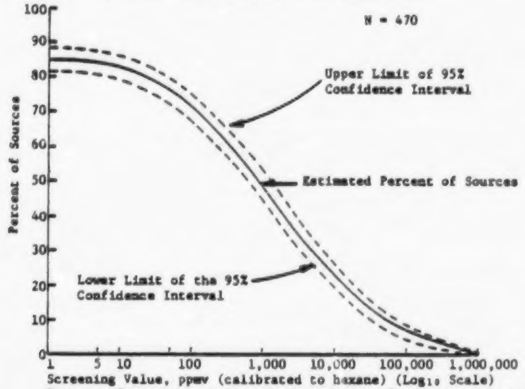
Percent of sources - indicates the percent of sources with screening values greater than the selected value.

Kosovo pumps: hydrocarbon liquids



Percent of sources - indicates the percent of sources with screening values greater than the selected value.

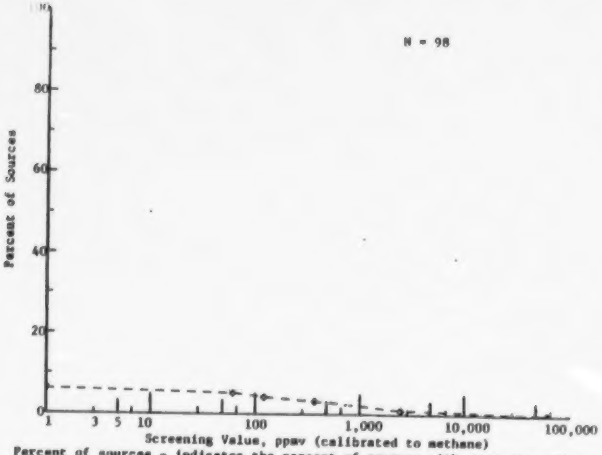
Refinery pumps: heavy liquids (from Reference 3)



Percent of sources - indicates the percent of sources with screening values greater than the selected value.

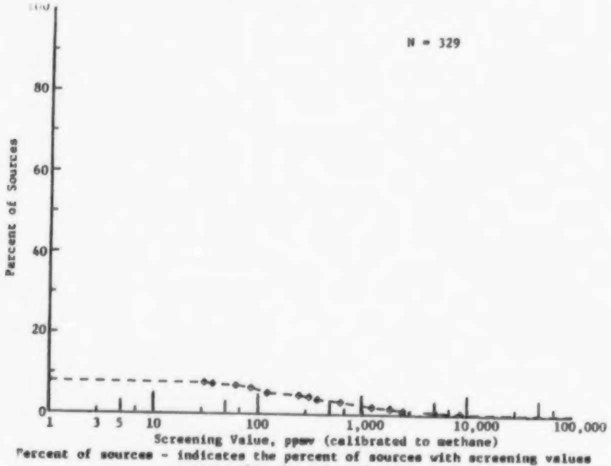
Refinery pumps: light liquids (from Reference 5)

Figure 5-9. Comparison of Leak Frequency for Kosovo and U.S. Refineries: Pumps/Hydrocarbon Liquids



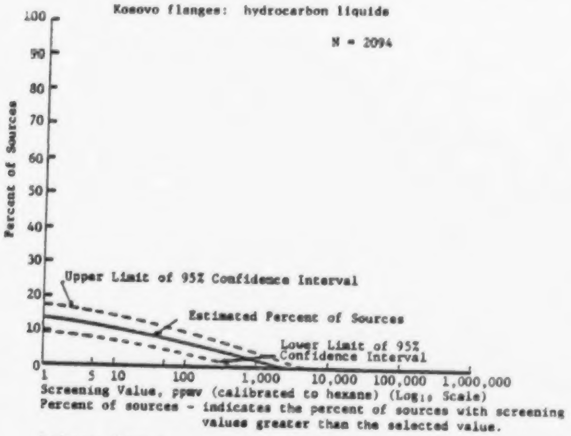
Percent of sources - indicates the percent of sources with screening values greater than the selected value.

Kosovo flanges: gas streams



Percent of sources - indicates the percent of sources with screening values greater than the selected value.

Kosovo flanges: hydrocarbon liquids



Percent of sources - indicates the percent of sources with screening values greater than the selected value.

Refinery flanges: all streams (from Reference 3)

Figure 5-10. Comparison of Leak Frequency for Kosovo and U.S. Refineries: Flanges

TABLE 5-2. COMPARISON OF FREQUENCIES OF LEAK OCCURRENCE FOR FUGITIVE EMISSION SOURCES WITHIN KOSOVO STREAM SUBGROUPS

Source Type Stream Service	Number Screened	Percent Leaking[a]	95% Confidence Interval for Percent Leaking[a]
Valves			
Gas (all)	254	11.8	(7.9, 16.2)
Raw Gas	150	6.7	(3.2, 12.0)
Clean Gas	46	34.8	(21.4, 50.3)
Other Gases	58	6.9	(1.9, 16.7)
Hydrocarbon Liquids (all)	403	11.9	(9.0, 15.6)
Methanol	216	18.5	(12.1, 24.9)
Other Hydrocarbon Liquids	187	4.3	(0.7, 7.9)
Pumps			
Hydrocarbon Liquids (all)	46	58.7	(43.2, 73.0)
Methanol	27	70.4	(49.8, 86.3)
Other Hydrocarbon Liquids	19	42.1	(20.3, 66.5)

[a] Leaking defined as having a screening value ⩾50 ppmv.

The leak frequency plots show the portion of sources that do not leak and the distribution of screening values of sources that do leak. It was not deemed worthwhile to prepare a frequency distribution plot for all of the stream subcategories in the Kosovo data base. Most of these distributions show a similar characteristic in the distribution of sources that do leak, where the percent of sources included drops sharply as the screening value increases. Therefore, the percent of sources that leak can be used to compare the characteristics of different source populations.

Table 5-3 shows the percent of sources leaking for various source/stream combinations at Kosovo, where leaking is defined as a source with a screening value greater than or equal to 200 ppmv. Table 5-3 also shows the percent of sources leaking for refinery data, where the definition of leaking is any source with a screening value greater than 200 ppmv. Although different screening devices and calibration gases were used in the U.S. refinery and Kosovo studies, subsequent testing has shown this to be a minor difference, compared to the inherent variability involved in making screening measurements.

5.2.2 Leak Rate/Screening Value Models

The models developed to relate screening values to measured mass emission rates were defined and presented in Section 4.3. In Figures 5-11 and 5-12, the models developed for Kosovo and for U.S. refineries are shown. As described in Section 5.2.1, the stream definitions are not consistent. Furthermore, the refinery models are for nonmethane emission rates, while the Kosovo models include methane. Because the Kosovo gasification plant's gas chromatograph was not operable during the testing, it was not possible to discriminate between

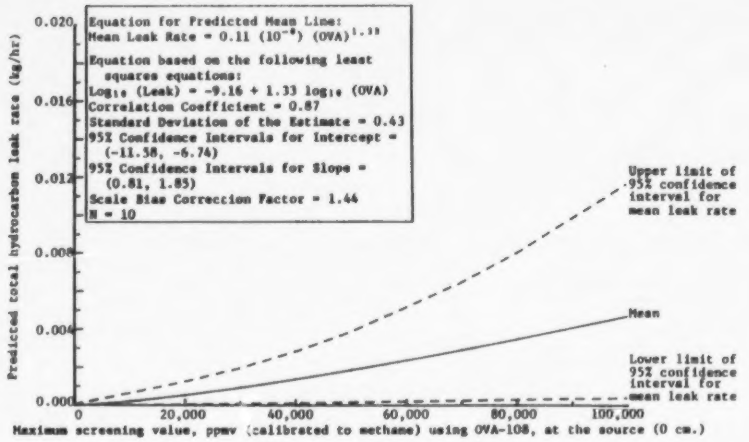
TABLE 5-3. COMPARISON OF FREQUENCIES OF LEAK OCCURRENCE FOR FUGITIVE EMISSION SOURCES AT KOSOVO AND U.S. REFINERIES

Source Type Stream Service	Kosovo		Refineries[a]	
	Number Screened	Percent[b] Leaking	Number Screened	Percent[c] Leaking
Valves				
Hydrogen	254	11.	135	43.0
Gas/Vapor			563	26.7
Light Liquids	403	11.	913	34.6
Heavy Liquids			485	5.9
Aqueous	235	1.	-	-
Pumps				
Light Liquids	46	28.	470	62.9
Heavy Liquids			292	21.6
Aqueous	23	17.	-	-
Flanges				
Gas/Vapor	781	3.	2094	2.7
Hydrocarbon Liquids	295	4.		
Aqueous	714	0.		
Open-Ended Lines				
Gas/Vapor	11	17.	129	22.4
Hydrocarbon Liquids	38	33.		
Aqueous	27	3.		

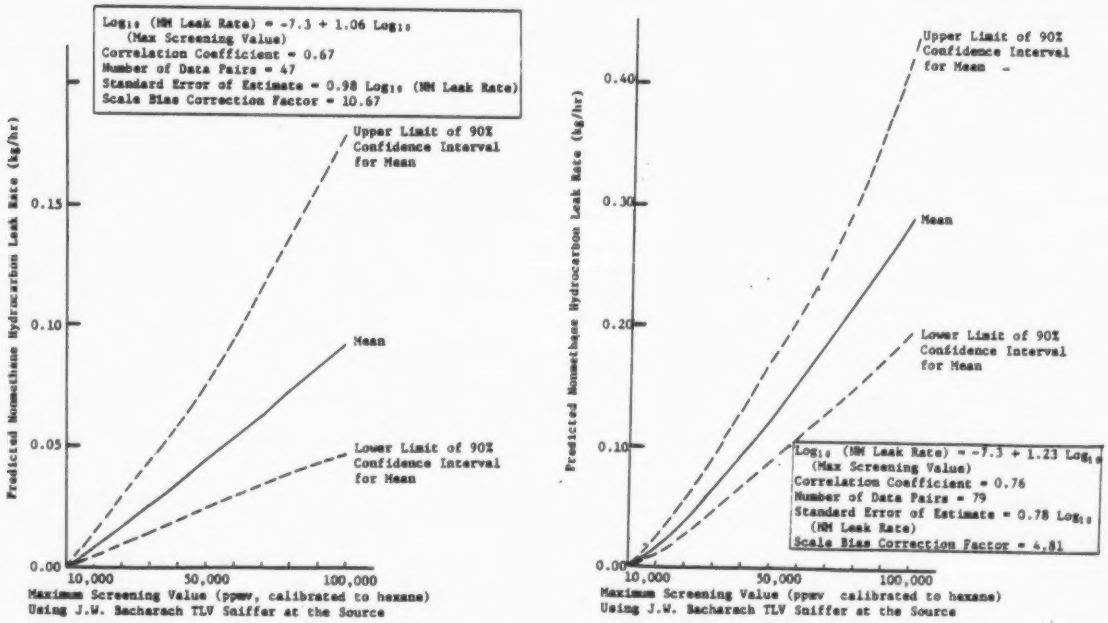
[a] From Reference 3

[b] Leaking defined as having a screening value ⩾200 ppmv, using OVA-108 calibrated to methane

[c] Leaking defined as having a screening value ⩾200 ppmv, using TLV Sniffer calibrated to hexane



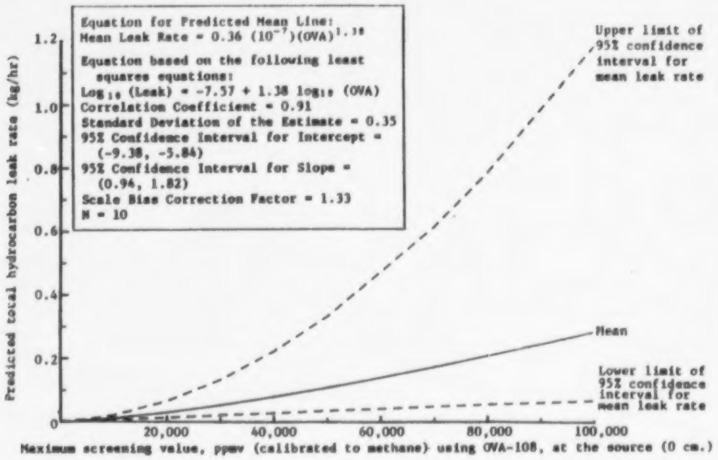
Kosovo: all sources in gas service



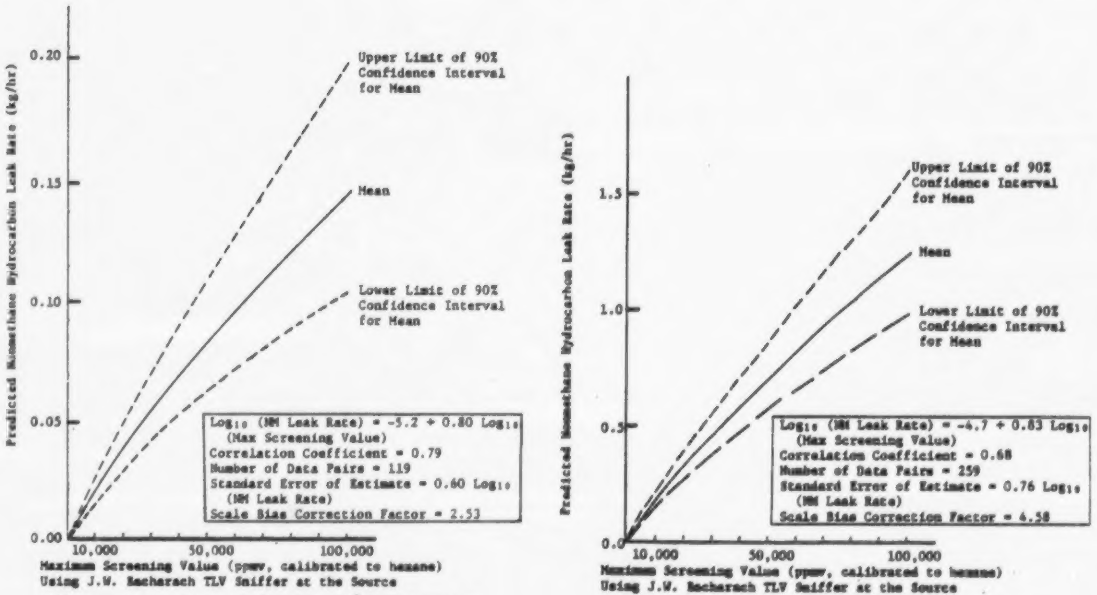
Refinery valves and compressors: hydrogen service (from Reference 3)

Refinery valves: gas/vapor service (from Reference 3)

Figure 5-11. Comparison of Nomographs for Predicting Leak Rates from Maximum Screening Values for Kosovo and U.S. Refineries: Gas Streams



Kosovo: all hydrocarbon liquids



Refinery valves: light liquid streams (from Reference 3)

Refinery pumps: light liquid streams (from Reference 3)

Figure 5-12. Comparison of Nomographs for Predicting Leak Rates from Maximum Screening Values for Kosovo and U.S. Refineries: Liquid Streams

methane/nonmethane hydrocarbons in the Kosovo samples. The plant gas chromatograph was also intended for use as a check on the accuracy of using the OVA-108 to analyze the bag samples collected during leak rate measurement. Since this was not possible, there is potentially some error in the calculated emission rates. Response factors were used to correct the concentration indicated by the OVA-108 for compounds such as methanol, phenol, and benzene on stream samples where these compounds were present.

5.2.3 Emission Factors

The results of the leak frequency determination and model development were combined to estimate emission factors, as described in Section 4.4. These emission factors and their 95 percent confidence intervals are compared to similar data from refineries in Table 5-4. Because the confidence intervals for some of these estimates are large, a graphical representation of the data is shown in Figures 5-13 through 5-15. In these figures, the box represents the emission factor, and the brackets show the range of the 95 percent confidence intervals. In the case of flanges, the confidence intervals overlap, and no conclusion can be made about the differences in emission factors. For valves and pumps, the confidence intervals do not overlap and, therefore, it appears that the emission factors for these sources in refineries and at Kosovo are significantly different. The inconsistencies in sampling and analytical techniques used in the two test programs could account for some difference in estimated emission factors. These inconsistencies might result in a difference of a factor of 2, but the confidence intervals for valves and pumps are at least one order of magnitude apart.

TABLE 5-4. COMPARISON OF EMISSION FACTORS FROM KOSOVO AND U.S. REFINERIES

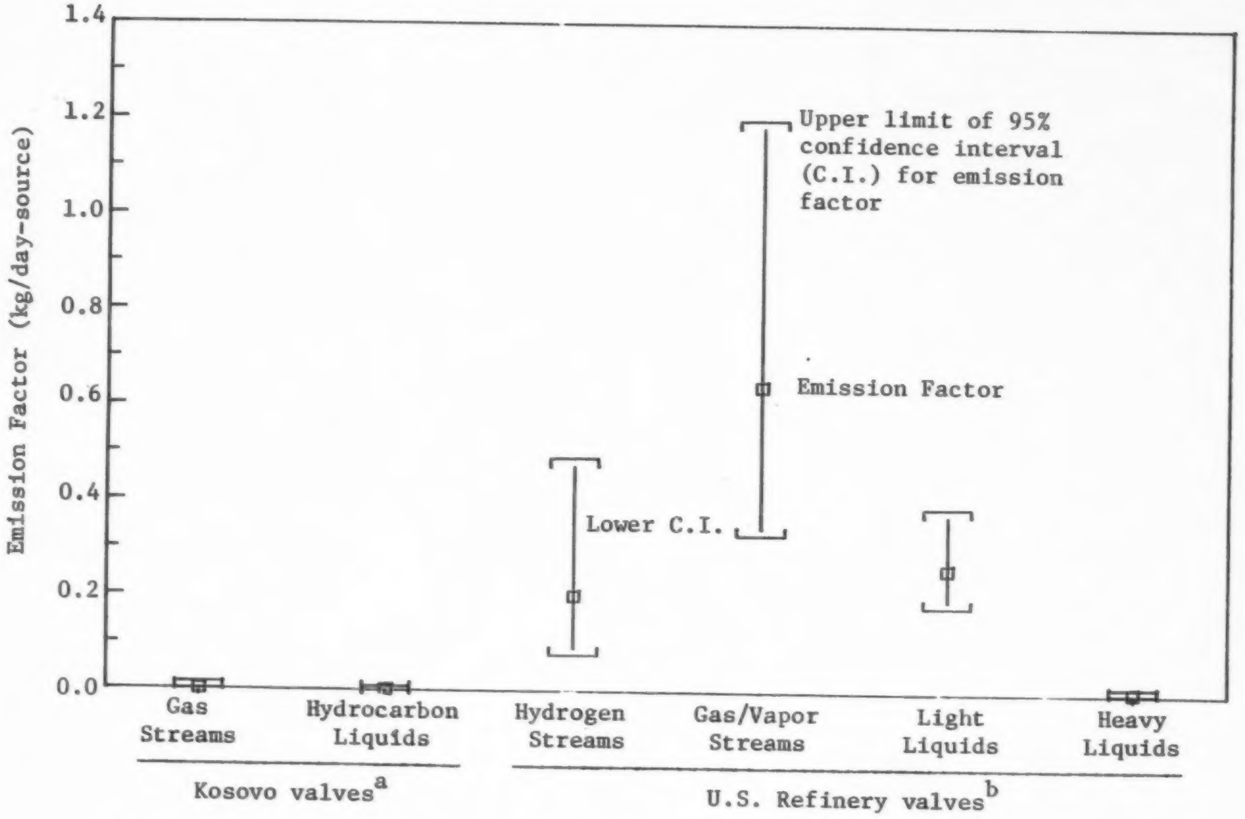
Source Category	Kosovo		Refinery	
	Emission Factor[c] Estimate (kg/day-source)[a]	95% Confidence Interval for Emission Factor	Emission Factor Estimate (kg/day-source)[b]	95% Confidence Interval for Emission Factor
Valves				
Hydrogen	-	-	0.20	(0.076, 0.49)
Gas	0.0019	(0.0002, 0.016)	0.64	(0.33, 1.2)
Light Liquid	0.0026	(0.0008, 0.01)	0.26	(0.18, 0.39)
Heavy Liquid			0.0054	(0.0022, 0.16)
Aqueous	0.0012	(Neg., 0.12)	-	-
Pumps				
Light Liquid	0.0050	(0.0009, 0.03)	2.7	(1.7, 4.0)
Heavy Liquid			0.50	(0.21, 1.2)
Aqueous	0.0012	(Neg., 0.0021)	-	-
Flanges				
Gas	0.00024	(Neg., 0.01)	-	-
HC Liquid	0.00048	(Neg., 0.02)	0.0061	(0.0022, 0.027)
Aqueous	Neg.	(Neg., 0.0004)		

[a] Total hydrocarbon emissions

[b] Non-methane hydrocarbon emissions (from Reference 5)

[c] For gaseous leaks from the indicated services (liquid drops are not included)

Neg. = $<3 \times 10^{-5}$ kg/day



[a] Total hydrocarbon emissions

[b] Nonmethane hydrocarbon emissions (from Reference 3)

Figure 5-13. Comparison of Emission Factors from Kosovo and U.S. Refineries: Valves

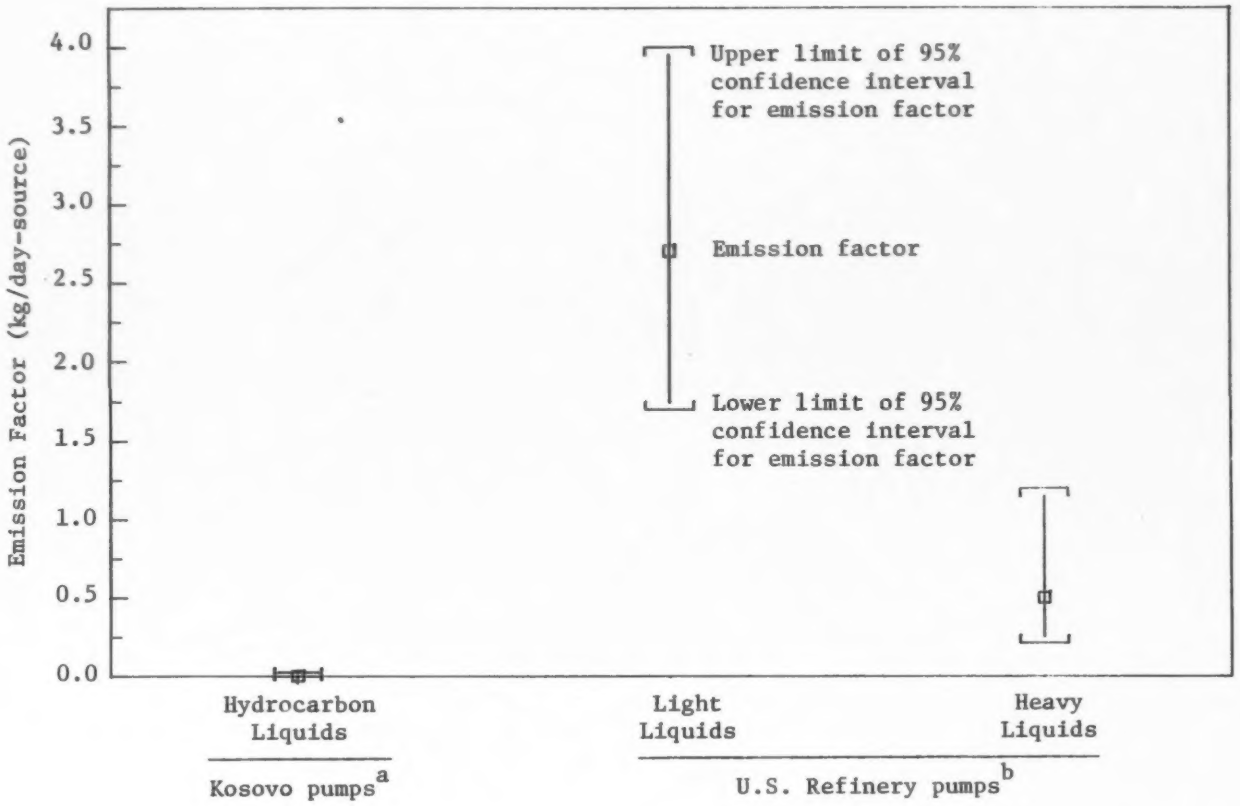
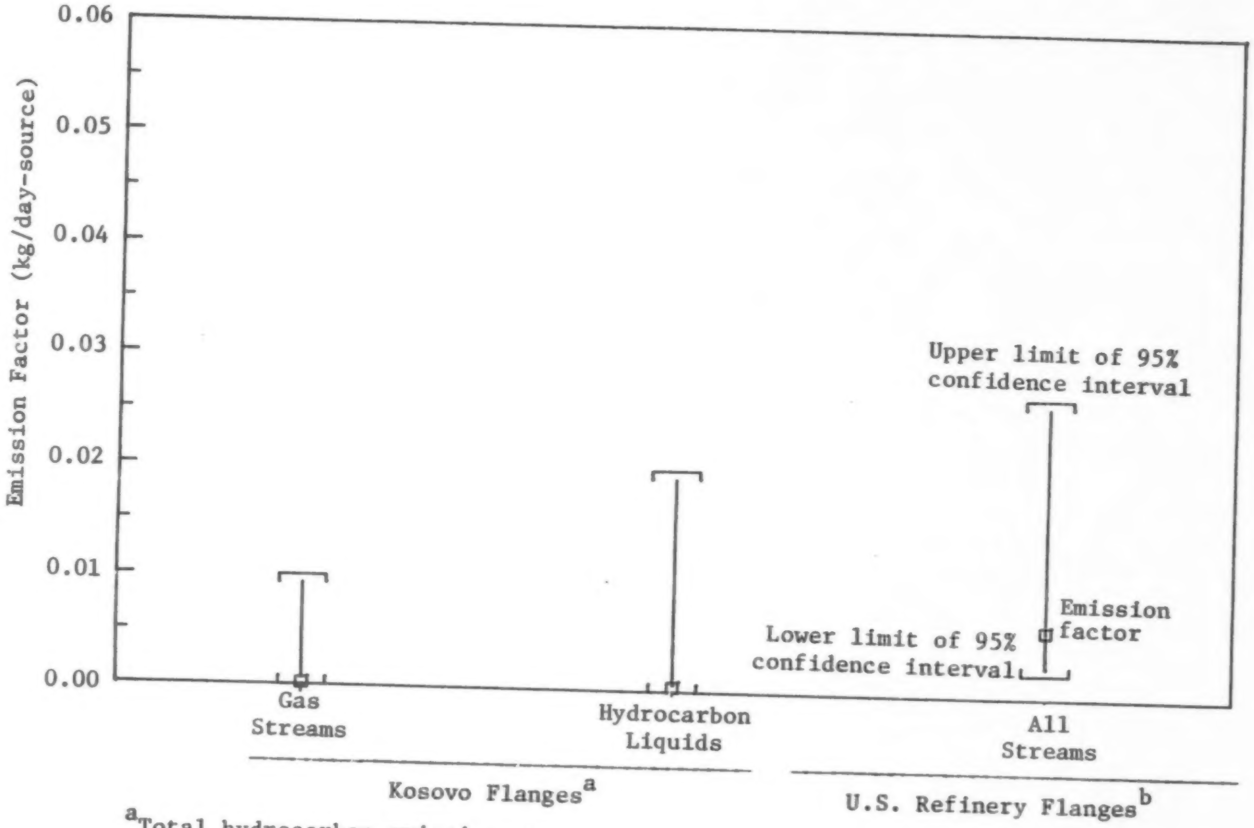


Figure 5-14. Comparison of Emission Factors from Kosovo and U.S. Refineries: Pumps



[a] Total hydrocarbon emissions

[b] Nonmethane hydrocarbon emissions (from Reference 3)

Figure 5-15. Comparison of Emission Factors from Kosovo and U.S. Refineries: Flanges

The refinery emission factors are listed here only to illustrate that there were differences in the results. Although it is not within the scope of this study to explain these differences, there are some differences in the process units (refineries versus the Kosovo coal gasification plant) which should be noted.

- Many of the Kosovo streams contained coal tar, a unique material which may act to plug process leaks.
- Many of the Kosovo gas streams contained 10-20 percent hydrocarbons while refinery gas streams are usually nearly 100 percent hydrocarbons. A given volume of gas leaked at Kosovo will contain fewer moles of hydrocarbons than the same volume of refinery gas.
- Kosovo hydrocarbons are primarily methane and ethane, while refinery hydrocarbon gases contain more heavier components. A given volume of Kosovo hydrocarbon gas will have less mass than its refinery counterpart.

5.3 RELATIVE SIGNIFICANCE OF FUGITIVE EMISSIONS

The total emission rate from fugitive sources in Kosovo process units was presented in Section 4.4. In this section, fugitive emissions are compared to the major process discharge streams at Kosovo. In addition to their significance with respect to total emissions, fugitive emissions are also an important factor with respect to industrial hygiene considerations.

The total contribution of fugitive emissions at Kosovo was estimated to be 5.7 kg/day of hydrocarbons and 0.5 kg/day of carbon monoxide. In Table 5-5, the emission rates from fugitive emission sources and from the ten major process discharge streams at Kosovo are shown. Three of these discharge streams are flared at Kosovo, and the emission rates shown for these streams are based on an assumed 90 percent destruction efficiency.

As shown in Table 5-5, fugitive emissions contribute a small fraction of the total emissions at the Kosovo plant. It is reasonable to expect that additional process discharge stream controls would be applied to a similar coal gasification plant built in the U.S. As the major process stream discharges are reduced, the relative contribution from fugitive emission sources is increased.

Although they are not the major contributor to total emissions at Kosovo, fugitive emissions are potentially significant with respect to industrial hygiene. While process discharge streams are released from a discrete emission point and can be conveyed to a control device or to remote release point, fugitive emissions are released from valves, pumps, flanges, etc., in all areas of all process units. Furthermore, fugitive emissions are released at locations where workers will come into immediate contact with the emissions. Because fugitive emissions are essentially the result of process fluid leakage, they may contain any of the potentially harmful compounds present in the process fluid. The composition of various Kosovo process streams can be found in Reference 2.

TABLE 5-5. ATMOSPHERIC EMISSION RATES FROM KOSOVO PROCESS DISCHARGE STREAMS AND FUGITIVE EMISSION SOURCES

Process Unit Emission Source	Uncontrolled Emissions (kg/day)		As Controlled at Kosovo (kg/day)	
	Hydrocarbons	Carbon Monoxide	Hydrocarbons	Carbon Monoxide
Rectisol				
H_2S-Rich Waste Gas	11,450	2,180	1,145[b]	218[b]
CO_2-Rich Waste Gas	5,630	TR[a]	5,630	TR
Fugitive Emissions	2.83	0.203	2.83	0.203
Phenosolvan				
Ammonia Stripper Vent	297	NF[c]	297	NF
Fugitive Emissions	0.957	NF	0.957	NF
Tar Separation				
Tar Tank Vent	0.648	TR	.648	TR
Medium Oil Tank Vent	15	5.51	15	5.51
Phenolic Water Tank Vent	29.2	NF	29.2	NF
Expansion Gases	173	16.9	17.3[b]	1.69[b]
Fugitive Emissions	0.921	0.0396	0.921	0.0396
Gasification				
Low Pressure Coal Lock Vent	71.3	16.8	71.3	16.8
High Pressure Coal Lock Vent	972	151	97.2	15.1
Fugitive Emissions[d]	1.0	0.221	1.0	0.221
By-Product Storage				
Naphtha Tank vent	9.14	NF	9.14	NF
Fugitive Emissions[e]	-	-	-	-
TOTALS				
Process Discharges[f]	18,650	2,370	7,310	257
Fugitive Emissions	5.71	0.464	5.71	0.464
Total	18,656	2,370	7,316	257

[a] TR = trace found in analysis

[b] Stream flared; assumed efficiency = 90%

[c] NF = not found in analysis

[d] Includes gasification and gas cooling (Fugitives from these two areas are based on two of six gasifiers and two of three gas-cooling trains in operation. Coal feed rate is approximately 30 metric tons per day with two gasifiers running.)

[e] Included in tar separation unit

[f] From Reference 4

In addition to direct worker contact with fugitive emissions at the time of their release, operating practices at Kosovo may cause additional worker exposure to process fluids. When process fluid samples are taken at Kosovo, the sample purge may be drained directly out onto the ground (or vented to the atmosphere if gaseous) or may be collected by the numerous open canals that serve as wastewater channels. The volatile compounds in these purges rapidly evaporate, but the heavier fractions may gradually accumulate. Workers can be exposed to these compounds by causing any disturbance of the accumulated material. It also appears that a similar situation has been created by equipment cleaning procedures at Kosovo. Tar has accumulated near heat exchangers that have been cleaned by first draining the process fluid onto the ground. Volatile fractions have evaporated, but the accumulated tar remains.

5.4 RECOMMENDATIONS

The recommendations given in this section pertain to:

- data gaps,
- test methods, and
- control technology

The Kosovo fugitive emission testing has provided a good data base to identify areas that have the greatest number of leaks. The Kosovo testing has also identified areas where test methods could be improved. Control technology similar to that applied in U.S. refineries and chemical plants is recommended for fugitive emissions from gasification plants using gasification technology similar to that used at Kosovo.

5.4.1 Data Gaps

The screening data collected at Kosovo are very complete due to the comprehensive test strategy used. The screening leak frequency plots show which source/stream combinations have the fewest leaks and which combinations have the most "large leaks." In any type of fugitive emission test program, whether for developing control strategies or for simply obtaining data, screening is the first test that should be performed. The results of a screening survey will show which areas require the most expenditure of resources for emission reduction or for additional data acquisition.

Because of the small number of sources subjected to emission rate measurement, the emission factors developed have wide confidence intervals. However, additional testing to improve these emission factors is probably not warranted. When compared to U.S. refinery emission factors, the confidence intervals for valve and pump emission factors do not overlap. This indicates that Kosovo emission factors are statistically different (lower) than U.S. refinery emission factors. The confidence intervals for flange emission factors overlap and, therefore, they may or may not be significantly different. As discussed in Section 5.1, there are many factors that can affect the true emission rate. Since some of these factors may be different in U.S. coal gasification plants, efforts to develop more accurate Kosovo emission factors are not warranted. Subsequent testing efforts should be directed toward other coal gasification plants (U.S. and foreign) to determine the emission characteristics of other types of gasification technology and to compare emission data from the same type of technology at different plant sites. The results of the Kosovo testing can be incorporated in the design of U.S. plants to reduce fugitive emissions from process streams containing hazardous compounds by minimizing the number of emission sources, and by specifying leak resistant design features, where appropriate. After a plant begins operation, leak screening surveys will identify areas where additional design, engineering, or leak repairs are needed.

5.4.2 Test Methods

Leak screening with a portable hydrocarbon detector is satisfactory for locating leaking sources in Lurgi coal gasification plants because the process streams have enough hydrocarbon content to cause a response on the hydrocarbon detector if any process fluid is leaking. When a leaking source was identified, it was also screened with Draeger® tubes to identify leakage of compounds such as CO, H_2S, NH_3, and HCN. This procedure was successful in all cases where the compound of interest was present in the process stream at a significant concentration. The dilution effect that is inherent in the screening method prevented any positive conclusions about emissions of trace components. Although the Draeger® tube method was successful for identifying sources emitting specific compounds, it would not be satisfactory as a primary screening method. The Draeger® tube method does not provide the fast response time that is required to efficiently locate the point of maximum leakage, and the hand-held bellows pump and glass detector tube are awkward for routine application to a large number of sources.

The emission rate measurement method used at Kosovo was the "flow through" method. This method was selected because it can be applied to higher leak rates than the "vacuum" method. The results of the Kosovo testing show that this large leak capability was not needed. Furthermore, the vacuum method can be operated at lower dilution rates, and analysis for minor species would have a greater chance for success. Because of the wide range of compounds that can be found in coal gasification process streams, emitted species identification would provide useful information. The Kosovo plant gas chromatograph was inoperable during the period when sampling was conducted; therefore, no species identification was possible.

The difficulties encountered when attempting to measure liquid leak rates identified another area where test methods could be improved. The types of difficulties that were encountered cannot be anticipated, and each situation will require assessment before an appropriate method can be developed. In addition to measurement of the liquid leak rates, the composition of the liquid leak would also need to be determined. Because U.S. operating practices and regulations may reduce the amount of "acceptable" liquid leakage, measurement of liquid leaks may not be a significant problem in U.S. fugitive emission testing at coal gasification plants.

5.4.3 Control Technology

Fugitive emission controls can be classified as one of two types of control:

- work practices, and
- equipment specifications.

Work practices include various strategies to identify leaking sources and to reduce the leakage. Equipment specifications provide emission control by requiring the use of specific types of equipment that either have a lower potential to leak, or that capture the leakage for recycle or disposal.

Fugitive emission controls have been thoroughly investigated during development of New Source Performance Standards for organic chemical plants by EPA (Reference 5). Because the emission sources (valve, pump, flange, etc.) are the same, these controls might also be applicable to coal gasification plants. Table 5-6 lists the controls that have been identified for each type of fugitive emission source, but it is not intended to be interpreted as a recommended control strategy. It is simply a presentation of all of the controls that could be applied to fugitive emission sources.

TABLE 5-6. FUGITIVE EMISSION CONTROLS

Source Type	Emission Control	
	Work Practice	Equipment Specification
Valves	Leak detection and repair	Diaphragm or bellows-sealed valves
Flanges	Leak detection and repair	
Pumps, compressors, agitators	Leak detection and repair, including visual inspection for liquid leakage	Double mechanical seals; enclosed seal area vented to control device
Open-ended lines	Leak detection and repair	Seal open end when not in use with cap, plug, or valve
Relief valves	Leak detection and repair, especially after overpressure release	Upstream rupture disks; closed vent discharge to flare
Sampling connections	Proper disposition of sample purge fluids	Closed loop sampling

SECTION 6.0

REFERENCES

1. Bombaugh, K.J., W.E. Corbett and M.D. Matson. Environmental Assessment: Source Test and Evaluation Report - Lurgi (Kosovo) Medium-Btu Gasification, Phase 1. EPA-600/7-79-190, EPA Contract No. 68-02-2608. Austin, TX. Radian Corporation. August 1979.

2. Bombaugh, K.J., R.V. Collins, K.W. Lee, et al. Environmental Assessment: Source Test and Evaluation Report - Lurgi-Type (Kosovo, Yugoslavia) Medium-Btu Gasification. EPA Contract No. 68-02-3137 and 2177. Austin, Texas. Radian Corporation. August 1981.

3. Radian Corporation. Assessment of Atmospheric Emissions from Petroleum Refining, Appendix B: Detailed Results. Austin, Texas. April 1980. EPA-600/2-80-075c.

4. Bombaugh, K.J., W.E. Corbett, K.W. Lee and W.S. Seames. Symposium on Environmental Aspects of Fuel Conversion Technology: V. U.S. EPA. Research Triangle Park, NC. September 1980.

5. U. S. EPA. VOC Fugitive Emissions in Synthetic Organic Chemicals Manufacturing Industry - Background Information for Proposed Standards. EPA-450/3-80-033a. U.S. EPA. Research Triangle Park, NC. November 1980.

APPENDIX A
CALIBRATION AND SCREENING PROTOCOL

Leaking sources were identified by using the Century Systems OVA-108 portable hydrocarbon detector to measure the hydrocarbon concentration at the potential leak sites of each source. Draeger® tubes were used to screen leaking sources for the presence of specific compounds. Calibration procedures for the OVA-108 are discussed in Section A.1. Screening procedures are detailed in Section A.2 for the OVA-108 and in Section A.3 for Draeger® tubes.

A.1 CALIBRATION PROCEDURES

Detailed calibration procedures carried out daily are given in the following steps:

1. Check battery charge and hydrogen pressure.
2. Refill or recharge as necessary.
3. Turn on the electronics, the sample pump, and the hydrogen flow.
4. Check the sample flow rate on the rotameter and check the system for leaks by covering the probe tip. The sample flow should fall from a reading of about two to near zero, and the pump should sound noticeably labored. Pump discharge leaks can be checked by covering the detector exhaust port.
5. After about 10 minutes warm-up time, check the internal electronic calibration points. Use the "calibrate" knob to set the high calibration at exactly 10,000 ppmv, and then switch to the low calibration. It should read between 9 and 11 ppmv. If not, remove the instrument from its case and adjust the span with the potentiometer marked R-4 (check your operating manual to be sure this is right for your model).

6. Ignite the hydrogen flame in the detector.

7. Fill a bag made of Tedlar, Mylar, or Teflon with the higher standard calibration gas, which should be about 8000 ppmv of methane in air (Note: standards in N_2 will extinguish the flame). Expel the contents of the bag to flush out any contaminants. This bag should be clearly identified and reserved for this gas only. Then refill the bag, attach a short length of Teflon tubing, and introduce the standard into the OVA. Note the reading and record it on the control chart provided in Section 7. If the reading is off by more than ± 5 percent, adjust it to read the exact value by turning the "calibrate" knob. Then extinguish the flame, readjust the electronic calibration using the "gas select" knob, and record the new "gas select" knob reading. Once this initial calibration is completed, the instrument can be checked any time during the day with the internal electronic calibrations. This should be done with the flame out to avoid any interferences. Major readjustments should seldom be necessary. If the instrument requires frequent recalibration or if the "gas select" reading gets outside of the 0.4 to 0.6 range, the instrument is probably in need of service.

8. Next check the calibration on the low range standard gas, which should be around 500 ppmv. Fill the bag with the standard, purge, and refill. Then read the concentration with the OVA. If the concentration falls within ±20 percent, record the reading and proceed. If the variation is between ±20 and ±40 percent, readjust the calibration to split the error evenly between the high and low standards. Readjust the electronic standards using the "gas select" knob. If the low reading is off by more than ±40 percent, the instrument is probably in need of repair.

9. The dilution probe should be calibrated daily and the carbon pack changed weekly. To calibrate the dilution probe, fill a bag with the high standard and read it with the dilution probe attached. If the standard is 8000 ppmv,

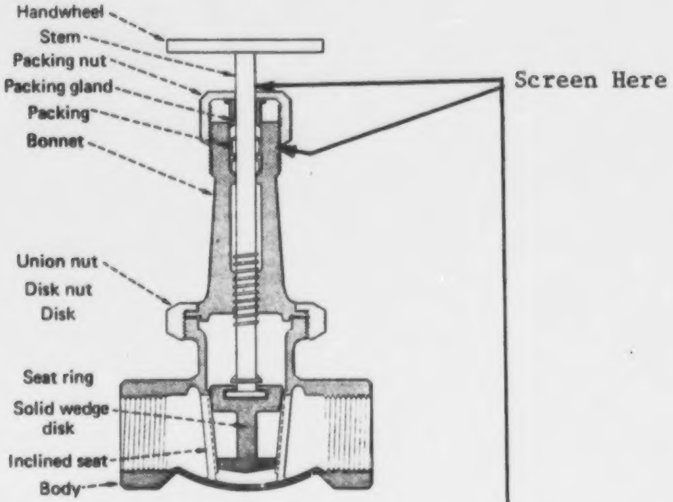
then the meter should read 800 ppmv. Record this reading on the control charts, and then adjust the pinch clamp on the dilution air line until it reads exactly a 10 to 1 dilution. If any contaminants should enter the dilution probe during sampling, it should be cleaned and recalibrated before reuse. To prevent such delays, it is helpful to slip a one-inch length of thin-wall Teflon tubing over the dilution probe tip to act as a guard. Care should also be taken to replace the cover on the dilution probe scrubber inlet when the probe is not in use. This will prevent premature saturation of the carbon pack.

The calibration gas standards that were used to calibrate the OVA-108 at Kosovo were mixtures of methane in air. Gas cylinders with 2016 ppmv methane were brought from the U.S. A gas cylinder with 4500 ppmv methane was obtained from INEP in Belgrade. Each of the two OVAs was calibrated with methane prior to shipment to Yugoslavia. At the first on-site calibration check, each OVA indicated 4500 ppm and 1600 ppm for the 4500 and 2016 standards, respectively. The OVAs were calibrated to these values each day. Subsequent analysis in the U.S. of the 2016 ppmv standard indicated that this reported value was correct, and the 4500 ppmv standard was apparently analyzed incorrectly. A correction to all data obtained in the OVAs was made to account for these low calibration values.

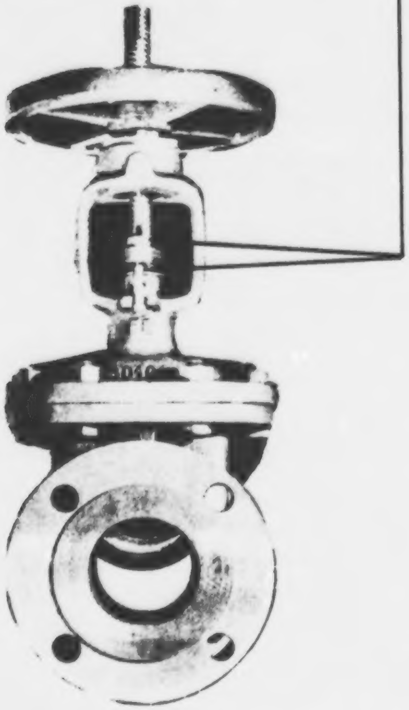
A.2 SCREENING WITH THE OVA

Once a fitting has been selected for screening:

1) Locate areas of potential leakage (valve stem, pump seal, etc. See Figures A-1 thru A-16 for details).


Handwheel
Stem
Packing nut
Packing gland
Packing
Bonnet
Union nut
Disk nut
Disk
Seat ring
Solid wedge disk
Inclined seat
Body
Screen Here

Rising Stem Type



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Nonrising Stem Type

Figure A-1. Gate Valves

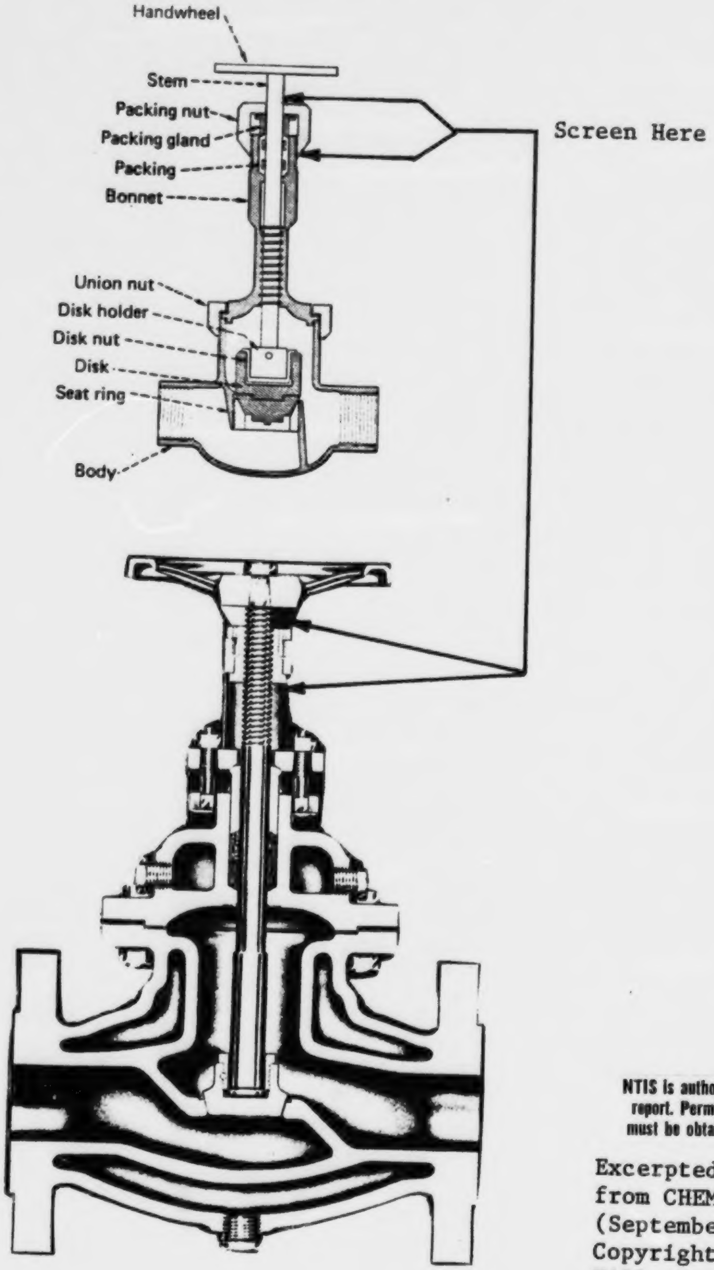
Handwheel
Stem
Packing nut
Packing gland
Packing
Bonnet
Union nut
Disk holder
Disk nut
Disk
Seat ring
Body
Screen Here

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Figure A-2. Globe Valves

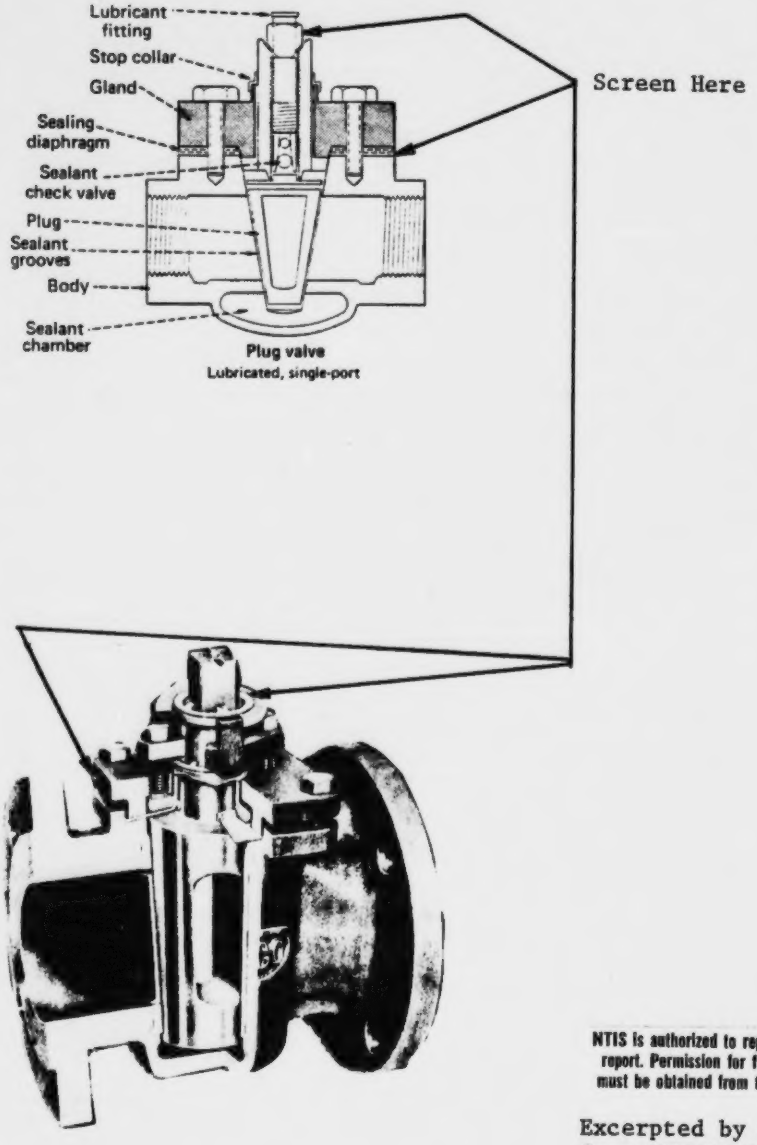
Lubricant fitting
Stop collar
Gland
Sealing diaphragm
Sealant check valve
Plug
Sealant grooves
Body
Sealant chamber
Plug valve
Lubricated, single-port
Screen Here

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Figure A-3. Plug Valves

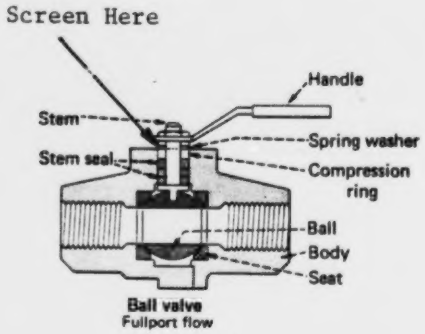
Screen Here
Handle
Stem
Spring washer
Stem seal
Compression ring
Ball
Body
Seat
Ball valve
Fullport flow

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Figure A-4. Ball Valve

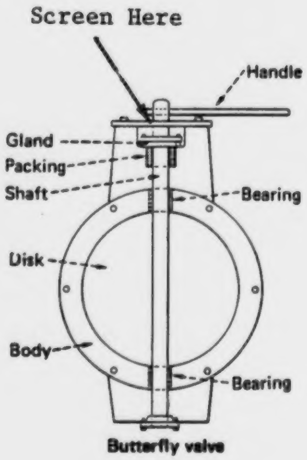
Screen Here
Handle
Gland
Packing
Shaft
Bearing
Disk
Body
Bearing
Butterfly valve

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Figure A-5. Butterfly Valve

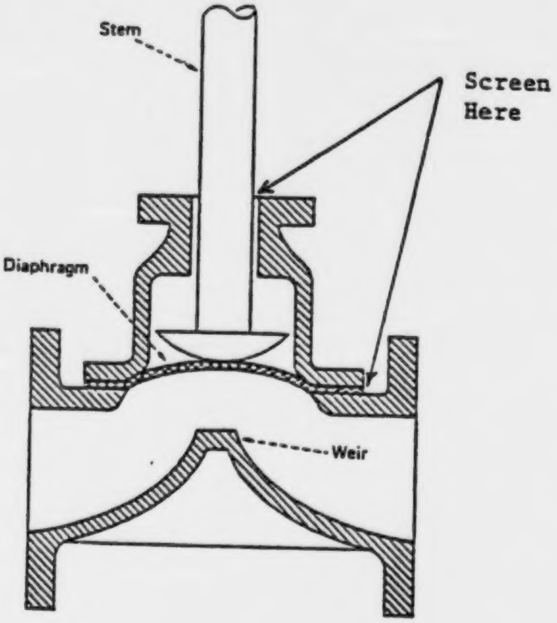
Stem
Screen
Here
Diaphragm
Weir

Figure A-6. Weir-Type Diaphragm Valve

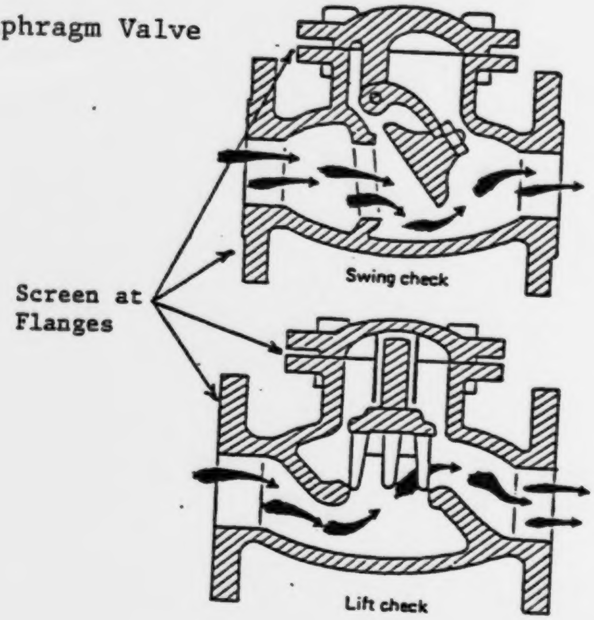
Swing check
Screen at
Flanges
Lift check

Figure A-7. Check Valves

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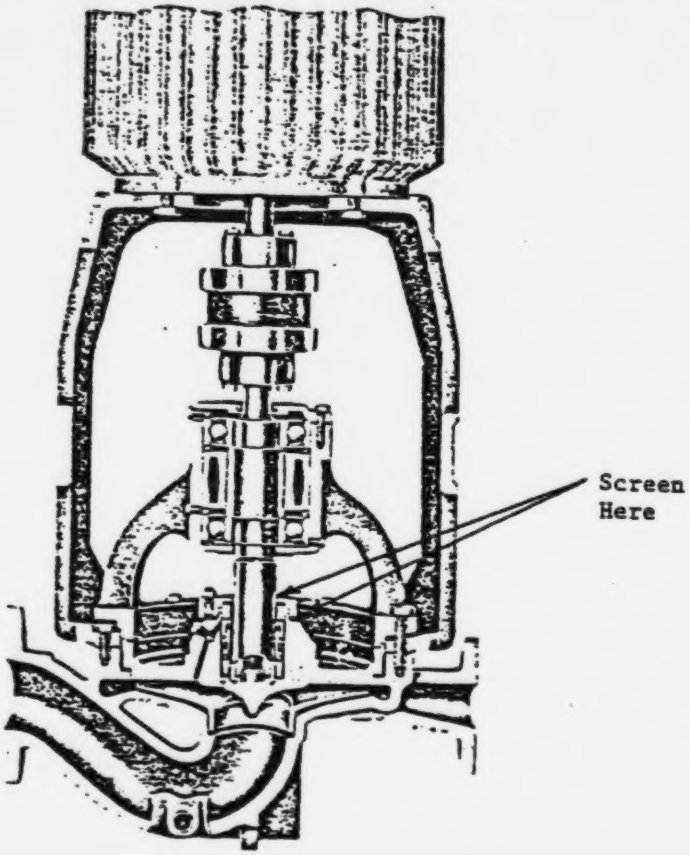

Screen
Here

Figure A-8. Vertical Centrifugal Pump

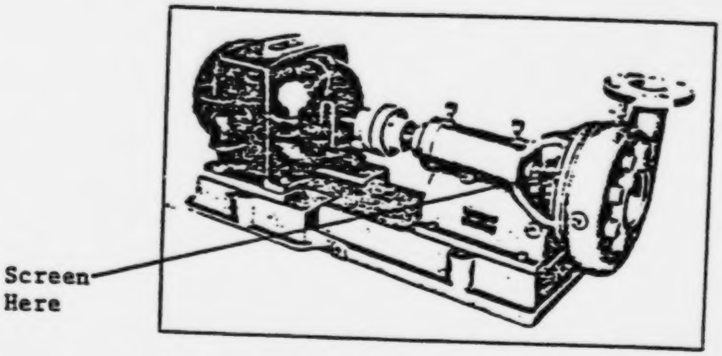

Screen
Here

Figure A-9. Horizontal Centrifugal Pump

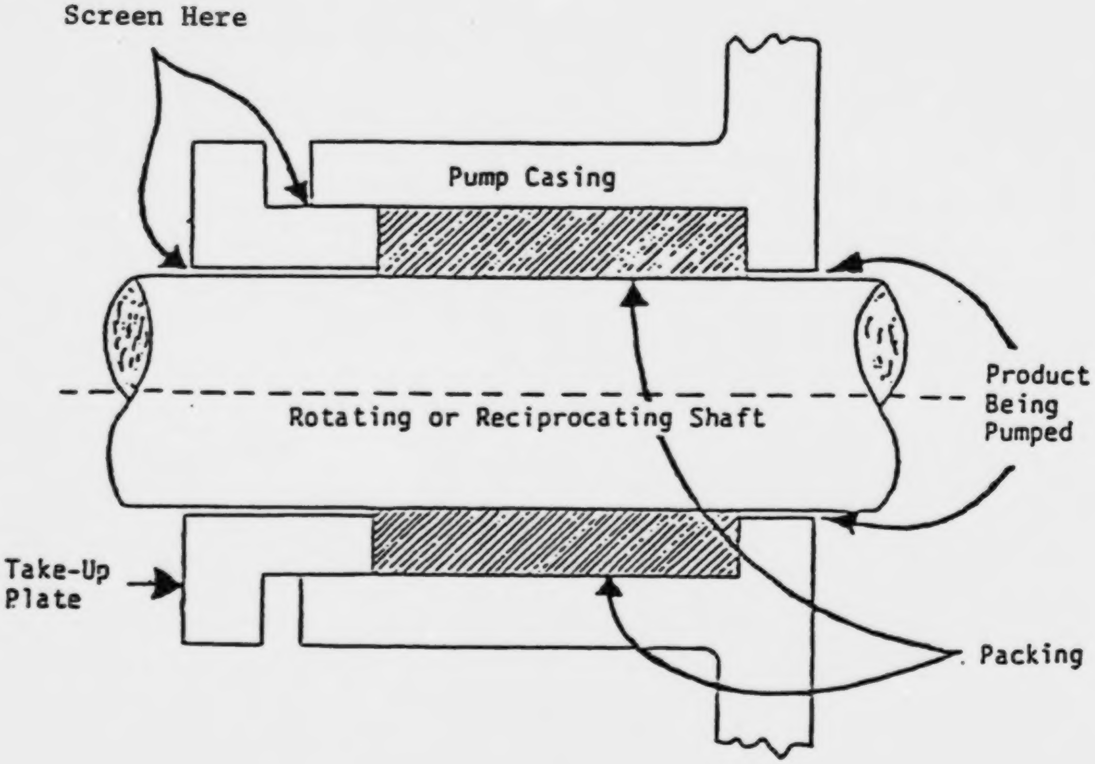

Screen Here
Pump Casing
Product Being Pumped
Rotating or Reciprocating Shaft
Take-Up Plate
Packing

Figure A-10. Diagram of a Simple Packed Seal

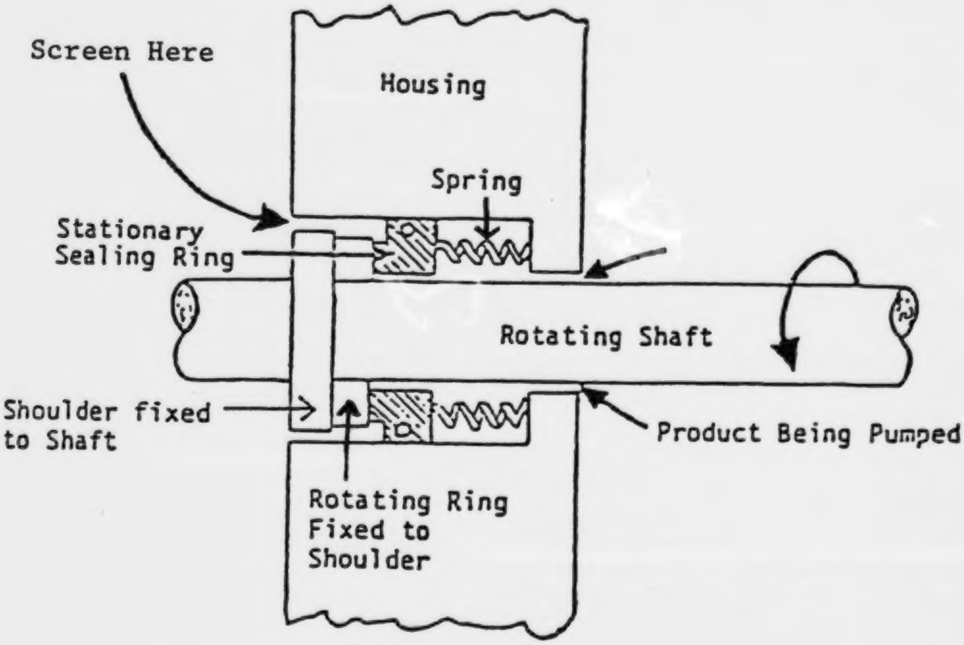
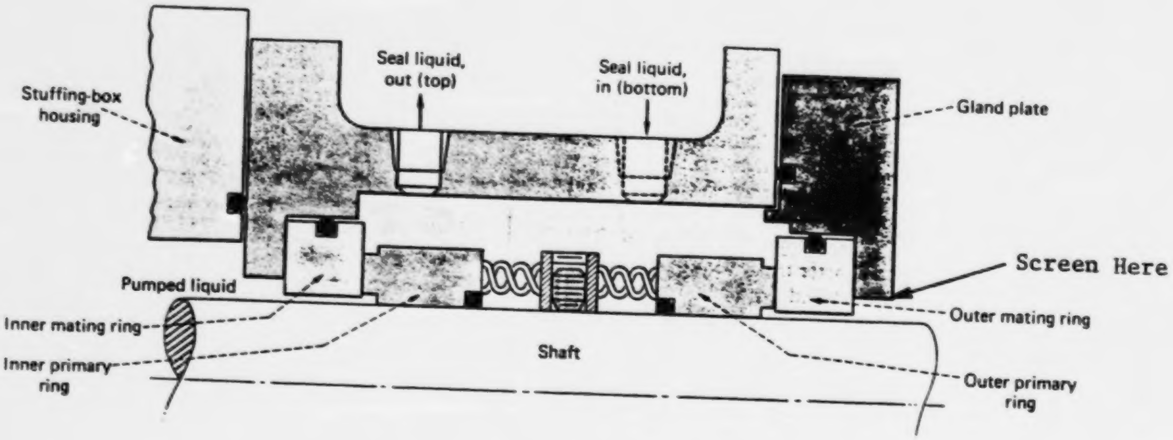

Screen Here
Housing
Spring
Stationary Sealing Ring
Rotating Shaft
Shoulder fixed to Shaft
Product Being Pumped
Rotating Ring Fixed to Shoulder

Figure A-11. Diagram of a Simple Mechanical Seal


Seal liquid, out (top)
Seal liquid, in (bottom)
Stuffing-box housing
Gland plate
Screen Here
Pumped liquid
Inner mating ring
Outer mating ring
Inner primary ring
Shaft
Outer primary ring

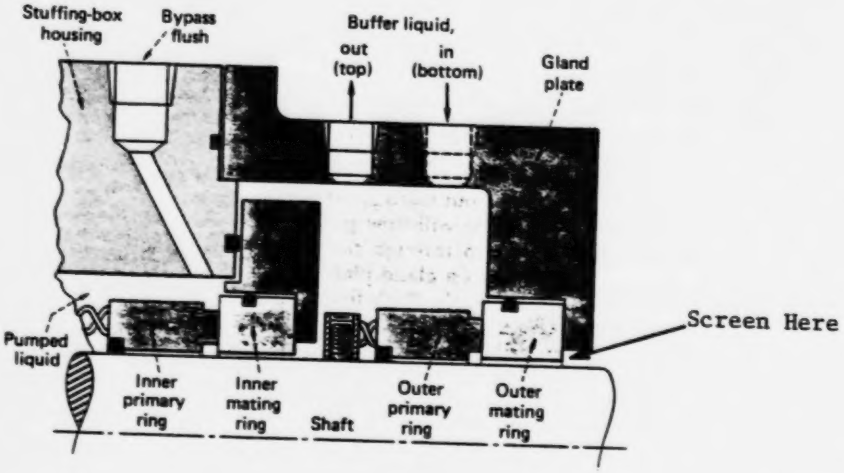

Stuffing-box housing
Bypass flush
Buffer liquid,
out (top)
in (bottom)
Gland plate
Screen Here
Pumped liquid
Inner primary ring
Inner mating ring
Shaft
Outer primary ring
Outer mating ring

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Figure A-12. Double Mechanical Seals for Pumps

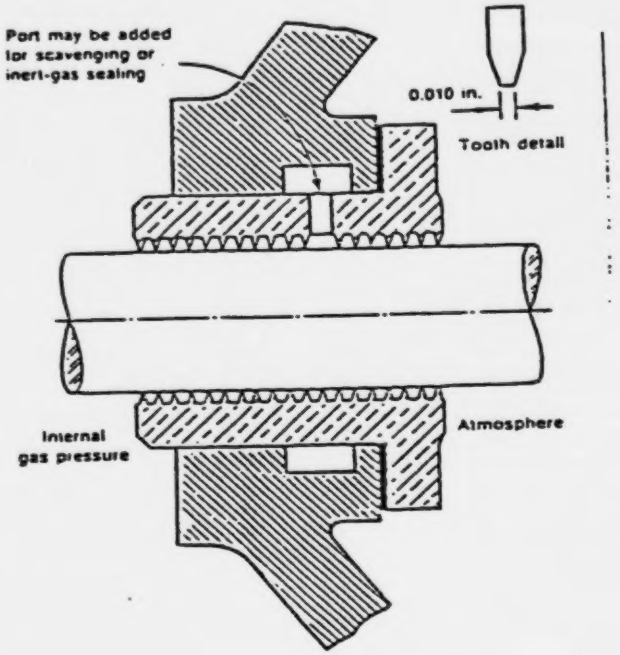
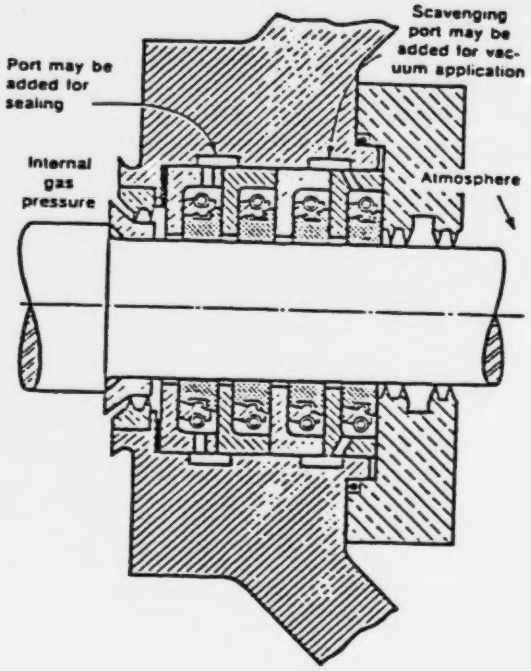

Port may be added for scavenging or inert-gas sealing
0.010 in.
Tooth detail
Internal gas pressure
Atmosphere

Figure A-13. Honeycomb Labyrinth Compressor Seal


Port may be added for sealing
Scavenging port may be added for vacuum application
Internal gas pressure
Atmosphere

RESTRICTIVE CARBON RING SEALS

Figure A-14. Mechanical Seals For Compressors

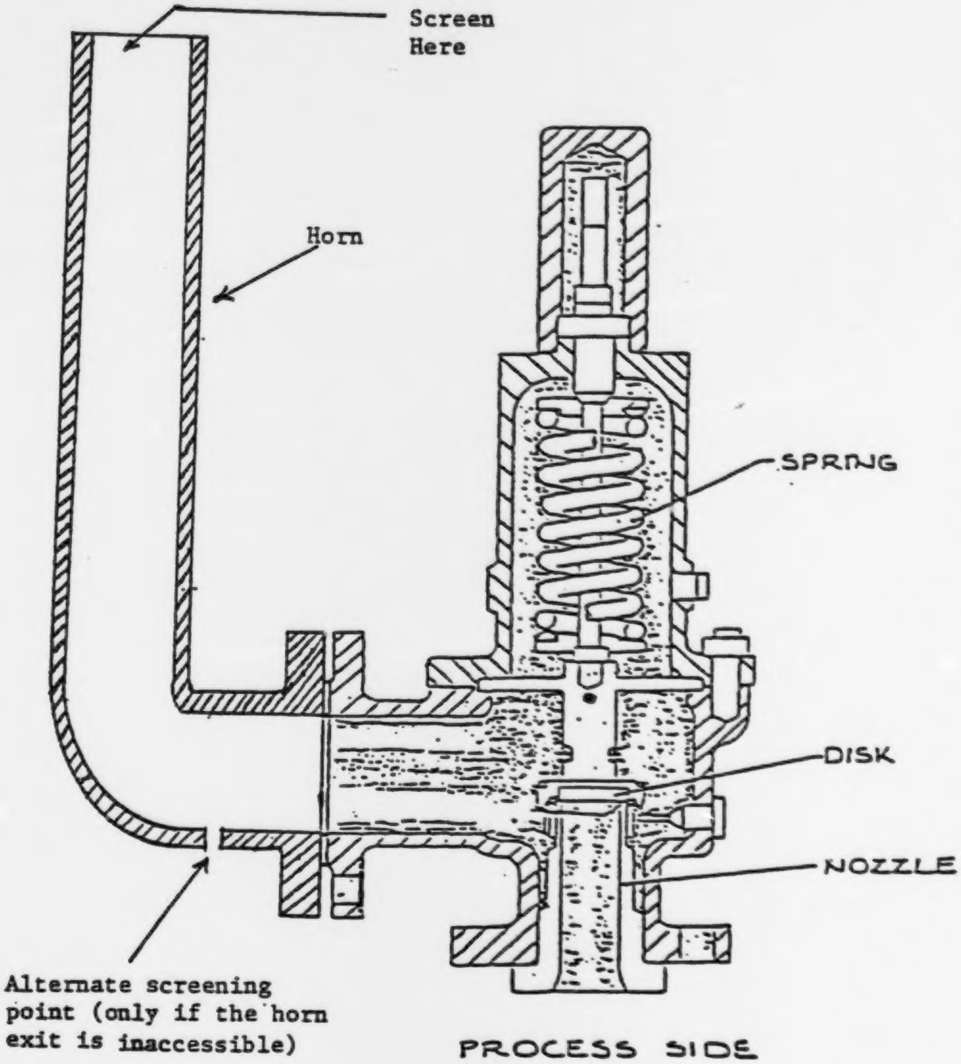
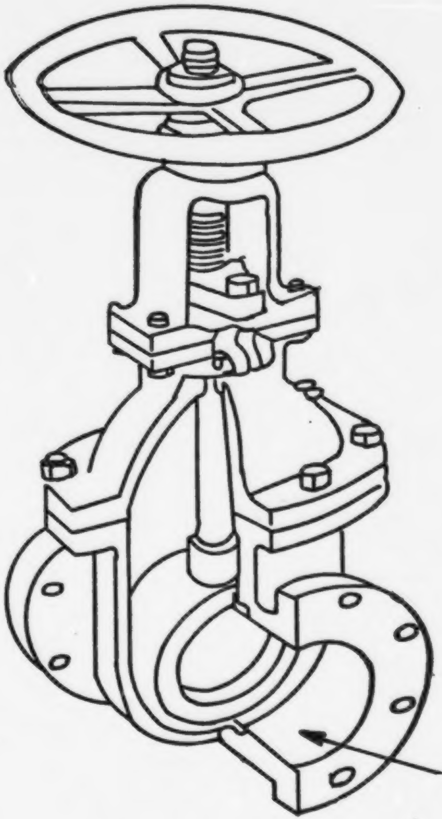

Screen
Here
Horn
SPRING
DISK
NOZZLE
Alternate screening point (only if the horn exit is inaccessible)
PROCESS SIDE

Figure A-15. Diagram Of A Spring-Loaded Relief Valve



Screen here (or at the opening of any connected piping)

Figure A-16. Diagram Of An Open-Ended Line

2) Using the probe tip of the OVA, make a slow traverse of the circumference of the potential leak area.

3) Find the point of maximum deflection and record that value under the OVA column.

4) Some sources will display large swings in the reading at a given point. Record the maximum reading that is repeated at least once for such sources.

5) Some areas will have a high background concentration. In general, if the background is less than 1/2 the maximum value, then record the net contribution from the source. If the background is more than 1/2 the maximum, but there is some additional contribution, note this but record no value. If the background is high, and there is no additional deflection at the source, record a screening value of zero.

A.3 SCREENING WITH DRAEGER TUBES

The screening of other components will be determined by a dilution factor analysis based on the OVA reading:

$$d = \frac{OVA}{L_{HC}}$$

where d is the fractional dilution factor, OVA is the hydrocarbon screening value determined previously, and L_{HC} is the estimated hydrocarbon concentration of the fluid in the line.

The dilution factor may then be used to estimate the screening value of other components by the relationship:

$$S_{xxx} = (d)(L_{xxx})$$

where S_{xxx} is the predicted screening value of component "xxx", and L_{xxx} is the estimated concentration of component "xxx" in the fluid in the line.

The procedure to be used for each other component is given in the following section based on this dilution factor analysis.

A.3.1 Carbon Monoxide Detector Tubes

Name	Range	Strokes
"CO 10/b"	100 to 3000 ppm	1
"CO 0.5%/a"	5000 to 70000 ppm	1

Indication: White turns brownish-green.

Interferences: Acetylene is indistinguishable from CO. Hydrocarbons and H_2S will interfere if they saturate the precleanse layer.

H_2 in excess of 50% by volume will turn the whole indicating layer green.

Screening Protocol:

1) If $(d)(L_{CO}) < 100$ ppm, do not screen for CO.

2) If $100 \text{ ppm} \leq (d)\ (L_{CO}) < 3000$ ppm, use the "CO 10/b" tube with 1 stroke.

3) If $3000 \text{ ppm} \leq (d)\ (L_{CO}) < 70{,}000$ ppm, use the "CO 0.5%/a" tube with 1 stroke.

4) If the "CO 10/b" tube shows a maximum and the "CO 0.5%/a" tube does not respond, record a screening value of 4000 ppm.

Extending the Range:

The range of either tube may be extended to lower concentrations by increasing the number of strokes, i.e., if the "CO 10/b" tube were given 10 strokes, the range would be 10 to 300 ppm.

A.3.2 Ammonia Detector Tubes

Name	Range	Strokes
"Ammonia 5/a"	50 to 700 ppm	1
"Ammonia 0.5%/a"	5000 to 100,000 ppm	1

Indication: Orange layer turns dark blue or violet.
Interferences: Hydrazine will react like ammonia, and amines will react but at a reduced sensitivity.

Screening Protocol:

1) If (d)(L_{NH_3}) < 100 ppm, do not screen for NH_3.

2) If 100 ppm $\leq$ (d)(L_{NH_3}) < 700 ppm, use tube "ammonia 5/a" with 1 stroke.

3) If 700 ppm $\leq$ (d)(L_{NH_3}) < 100,000 ppm, use tube "ammonia 0.5%/a" with 1 stroke.

4) If step 3) does not give an indication, continue to stroke the same tube up to a total of 10 strokes, or until a good indication is achieved. Calculate screening value by:

$$SV = \frac{1}{n} \text{(indicated reading)}$$

where n is the number of strokes used.

A.3.3 Hydrogen Sulfide Detector Tubes

Name	Range	Strokes
"H_2S 100/a"	100 to 2,000 ppm	1
"H_2S 0.2%/a"	2,000 to 70,000 ppm	1

Indication: "100/a" white turns brown; "0.2%/a" pale blue turns black.

Interferences: Exhibits some co-sensitivity with SO_2. SO_2 alone will not react, but it may cause H_2S concentrations to be up to 50% high when the two co-exist (i.e., 10 PPM H_2S + 100 PPM SO_2 would indicate at 15 PPM H_2S). This is primarily a long range phenomenon. With the "H_2S 0.2%/a" tube, SO_2 may cause a yellowish discoloration, this will not affect the black H_2S stain line.

Screening Protocol:

1) If $(d)(L_{H_2S}) < 100$ ppm, do not screen for H_2S.

2) If 100 ppm $\leq (d)(L_{H_2S}) <$ 2000 ppm, use tube "H_2S 100/a" with 1 stroke.

3) If 2000 ppm $\leq (d)(L_{H_2S})$, use "H_2S 0.2%/a" with 1 stroke.

A.3.4 Hydrogen Cyanide Detector Tubes

Name	Range	Strokes
"HCN 2/a"	2 to 30 ppm	5
	10 to 150 ppm	1

Indication: Yellow turns red.

Interferences: Precleansing layer will retain H_2S, NH_3, SO_2, NO_2, and HCl. Capacity of the precleansing layer is about 500 ppm H_2S at 5 strokes or 2500 ppm at 1 stroke. If the capacity of the precleansing layer is not exceeded, only very slight interference is expected and then only when measuring very low HCN concentrations.

Screening Protocol:

1) If $(d)(L_{HCN}) < 10$ ppm, do not screen for HCN.

2) If $(d)(L_{HCN}) \geq 10$ ppm, use "HCN 2/a" tube with 1 stroke. If no indication occurs, use up to 5 strokes. Note the previously determined H_2S concentrations before wasting a tube on a stream with greater than 2500 ppm H_2S.

Record all screening data in accordance with the instructions supplied with the data sheet.

APPENDIX B
SAMPLING PROTOCOL

Several leaking sources were selected for leak rate measurement (sampling). These sampling procedures are explained in Sections B.1 through B.4 for the four main sampling activities:

- Rescreening
- Source enclosure
- Sampling module assembly
- Sampling module operation

B.1 RESCREENING THE SOURCE

Rescreen the source using the OVA to determine if there has been any significant change in screening value since the original screening.

Select the other species for rescreening based on a high original screening value or expected presence at the source. Procedures should be identical to those described in the screening protocol.

B.2 CONSTRUCTING THE SOURCE ENCLOSURE

B.2.1 Examine the source geometry and decide on the desired enclosure configuration. It may be helpful to clean the source at this time using rags, brushes, and/or steam to better define the surfaces on which a good tape seal can be achieved. The choice of an enclosure configuration is subjective, but it should consider:

- completely enclosing the leaking area,
- facilitate good sealing,
- have a minimum volume, and
- be as symmetrically shaped as possible.

While these criteria may often be conflicting, a suitable compromise can usually be achieved.

B.2.2 Based on the selected enclosure configuration, select the thickness of Mylar to be used in construction. Most enclosures will be complex enough to require the flexibility of the thin Mylar (4 mils). Certain small, regularly shaped enclosures can be constructed effectively of thick Mylar (14 mils).

B.2.3 Cut the selected Mylar into one or more pieces as dictated by the source geometry. Install three bulkhead fittings in the Mylar, two 0.5 inch (12 mm) fittings to act as the main inlet and outlet, and a 0.25 inch (6 mm) fitting to act as a pressure tap. If thin Mylar is the primary material of construction, a small square of thick Mylar should be used to reinforce the area where the bulkhead fitting is attached. The two 0.5 inch (12 mm) fittings should be installed at opposite sides of the enclosure so as to assure a good "sweeping" action across the leak area.

B.2.4 Tape the Mylar in place on the source using the geometry of the source for support. Care should be taken to make all taped seals as tight as possible. If it is not possible to get the metal surfaces clean enough for good adhesion, the Mylar can be wrapped completely around the source, and Mylar-to-Mylar seals can be made. Care should always be taken to avoid exposing the duct tape adhesive to the interior of the enclosure.

B.3 ASSEMBLING THE SAMPLING MODULE

B.3.1 The sampling equipment used is to be connected as shown in Figure B-1. Locate the nearest utility stations for compressed air and electricity. Make a decision on which to use based on ease of access. Compressed air will be considered as the primary utility, but electrical power may be substituted if necessary.

B.3.2 Connect an extension cord to the utility station outlet and run it to the sampling site. Connect the extension cord outlet to point (1) on the sampling module (See Figure B-2).

B.3.3 If compressed air is to be used, connect the appropriate length of 0.5 inch (12 mm) air hose to the utility station and run it to the sampling site. Remove end cap (12) and connect an air regulator to the line. Connect the air hose to the inlet of the regulator.

B.3.4 Connect a length of flexible 2 inch (50 mm) hose to the sampling module outlet (20). Connect the other end of this hose to the 0.5 inch (12 mm) bulkhead fitting in the source enclosure.

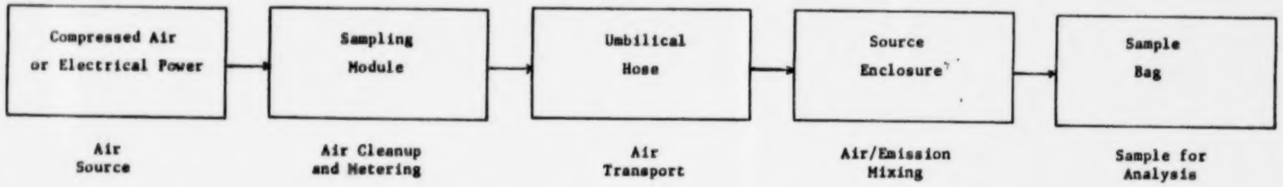
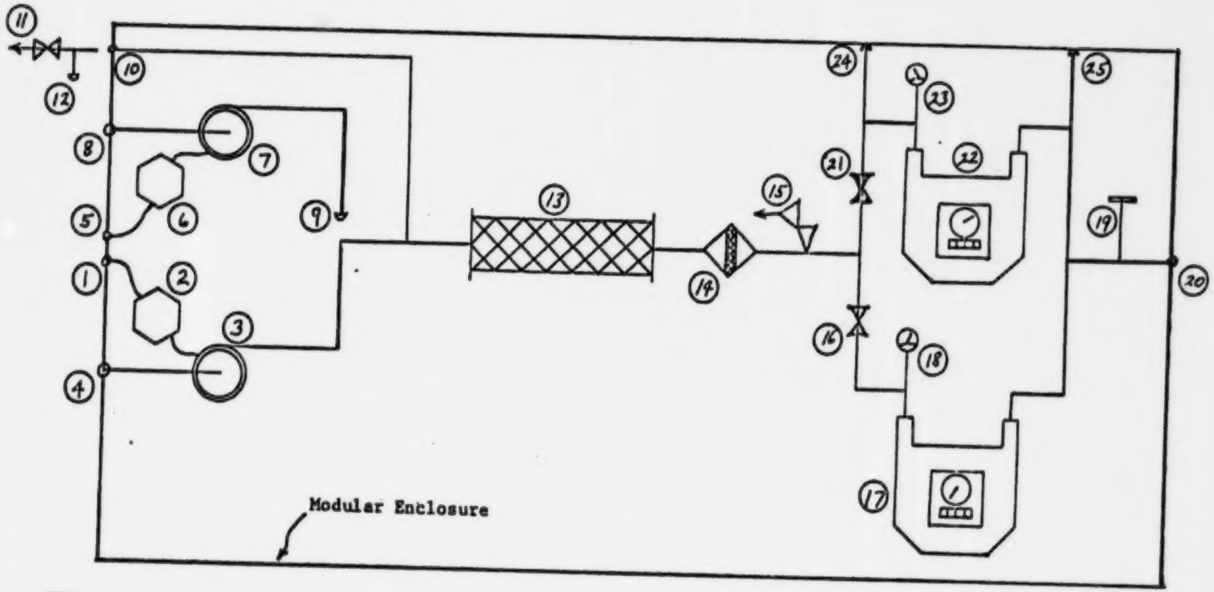

Compressed Air
or Electrical Power
Air
Source
Sampling
Module
Air Cleanup
and Metering
Umbilical
Hose
Air
Transport
Source
Enclosure
Air/Emission
Mixing
Sample
Bag
Sample for
Analysis

Figure B-1. Functional Relationships Of Sampling Equipment



11
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16
18
17
Modular Enclosure

KEY

(1) and (5) are electrical connectors
(2) and (6) are transformers
(3) and (7) are "High Vol" blowers
(4) and (8) are blower suction points
(9) is an end cap
(10) is a wall connection point
(11) is the blower bypass valve
(12) is the end cap
(13) is a charcoal filter module
(14) is a glass wool filter
(15) is a relief valve
(16) and (21) are ball valves
(17) and (22) are dry gas meters
(18) and (23) are pressure gauges
(19) is a dial thermometer
(20) is the outlet connection (to source enclosure)
(24) and (25) are end caps

Figure B-2. Schematic Diagram of the Sampling Module

B.4 OPERATING THE SAMPLING MODULE

B.4.1 Decide on an initial target flow rate based on the OVA screening value:

0 to 10,000 ppmv use about 1.7 m^3/hr (1 CFM),
10,000 to 100,000 ppmv use about 3.4 m^3/hr (2 CFM),
over 100,000 ppmv use about 6.8 m^3/hr (4 CFM).

B.4.2 Set the module flow configuration based on the target flow rate:

up to 5 m^3/hr (3 CFM) - open valve (16) and close (21),
5 m^3/hr (3 CFM) to 10 m^3/hr (6 CFM) - open both valves (16) and (21),
10 m^3/hr (6 CFM) to 15 m^3/hr (9 CFM) - open both valves (16) and (21) and remove end caps (24) and (25) and install a third dry gas meter.

B.4.3 Start air flow by turning on the "high Vol" blower (3). [Blower (7) is primarily a spare, but both may be used in parallel if higher flow rates are required. If compressed air is being used, start the flow by adjusting the regulator connected to point (12).]

B.4.4 Check conditions throughout the sampling module:

- the pressure at points (18) and (23) should not exceed 34 kPa gauge (5 psig),

- the appropriate dry gas meter should be indicating flow,

- check the temperature at point (19),

- check the bypass valve (11) to see that the "High Vol" blowers [(3) and/or (7)] are not being overloaded by back pressure,

- check the gas at point (20) with the OVA for any contamination which might escape the charcoal filter (13).

B.4.5 Check conditions at the source enclosure. A slight internal pressure should register on the Magnehelix, at least 0.12 kPa (0.5 inches of water). If not, check the enclosure and fittings carefully for leaks, and make improvements. Increasing the air flow rate can also help if no satisfactory results can be obtained by improving enclosure seals.

B.4.6 Check the hydrocarbon concentration at the source enclosure outlet with the OVA. Optimum accuracy will be obtained when the outlet concentration is between 1000 and 10,000 ppmv, but the OVA can measure up to 100,000 ppmv with a dilution probe. Adjust the air flow rate (if appropriate) to achieve the desired concentration. Check the dry gas meter flow configuration to be sure it is proper for the new flow rate.

B.4.7 Continue to monitor the source enclosure outlet with the OVA until a steady equilibrium situation is achieved. Record the sampling module conditions on the "sampling data sheet" as per the instructions included with that sheet.

B.4.8 Fill a "Tedlar" sample bag from the enclosure outlet. Using a short piece of thin-walled "Teflon" tubing as a collar, measure the concentration in the bag with the OVA and the appropriate Draeger tubes. The methodology for using the Draeger tubes will be quite similar to that given in the "Screening Protocol." The dilution factor is again expressed as follows:

$$d = \frac{OVA}{L_{HC}} \quad .$$

The dilution factor, d, is calculated as the ratio of the OVA reading on the bag to the estimated hydrocarbon concentration in the line. Record all the analytical results on the sampling data sheet.

B.4.9 Shutdown the air supply and disconnect the sampling module from the source enclosure and the utility station. Strip the enclosure off of the source. Allow about 5 minutes for the source to come to equilibrium with the atmosphere, and rescreen with the OVA and appropriate Draeger tubes.

APPENDIX C
DATA RECORDING CODES

The alphanumeric codes that were used to record raw data during testing are listed in Tables C-1 through C-3. These codes were used in conjunction with the data sheets shown in Appendix D. These codes also appear in the raw data listing in Appendix H. In Table C-3, the process stream codes that were used in previous Kosovo studies are also listed. These code numbers correspond to specific sampling points in the process lines, and therefore, many sampling points may be in a single stream code, as defined in this study.

TABLE C-1. PROCESS UNIT CODES

Process Unit	Code
Gas Production	1
Rectisol	2
Phenosolvan	3
Gas Cooling	4
Tar Separation	5

TABLE C-2. SOURCE TYPE CODES

	Source	Code
	Flange	1
	Process drain	2
	Open-end line	3
	Agitator seal	4
	Relief valve	5
Valves	Block valve - gate type	10
	Block valve - globe type	11
	Block valve - plug type	12
	Block valve - ball type	13
	Block valve - butterfly type	14
	Block valve - other types	15*
	Control valve - gate type	20
	Control valve - globe type	21
	Control valve - plug type	22
	Control valve - ball type	23
	Control valve - butterfly type	24
	Control valve - other types	25*
On-line Pump Seals	Single, mechanical, emission point at seal	30
	Single, mechanical, emission point at vent	31
	Single, mechanical, other emission point	32*
	Double, mechanical, emission point at seal	33
	Double, mechanical, emission point at vent	34
	Double, mechanical, other emission point	35*
	Single, packed, emission point at seal	36
	Single, packed, emission point at vent	37
	Single, packed, other emission point	38*
	Sealless pumps	39*

*Explain in the comment field.

(Continued)

TABLE C-2. (Continued)

Source		Code
Off-line Pump Seals	Single, mechanical, emission point at seal	40
	Single, mechanical, emission point at vent	41
	Single, mechanical, other emission point	42*
	Double, mechanical, emission point at seal	43
	Double, mechanical, emission point at vent	44
	Double, mechanical, other emission point	45*
	Single, packed, emission point at seal	46
	Single, packed, emission point at vent	47
	Single, packed, other emission point	48*
	Sealless pumps	49*
On-line Compressor Seals	Single, mechanical, emission point at seal	50
	Single, mechanical, emission point at vent	51
	Single, mechanical, other emission point	52*
	Double, mechanical, emission point at seal	53
	Double, mechanical, emission point at vent	54
	Double, mechanical, other emission point	55*
	Single, packed, emission point at seal	56
	Single, packed, emission point at vent	57
	Single, packed, other emission point	58*
	Sealless compressors	59*
Off-line Compressor Seals	Single, mechanical, emission point at seal	60
	Single, mechanical, emission point at vent	61
	Single, mechanical, other emission point	62*
	Double, mechanical, emission point at seal	63
	Double, mechanical, emission point at vent	64
	Double, mechanical, other emission point	65*
	Single, packed, emission point at seal	66
	Single, packed, emission point at vent	67
	Single, packed, other emission point	68*
	Sealless compressors	69*

*Explain in the comment field.

TABLE C-3. PROCESS STREAM CODES

Process Unit Stream	Stream Code	Sampling Location Codes From Previous Kosovo Studies
Gasification & Gas Cooling		
Raw Gas	01G	3.2,3.3,3.6
Gas Condensate	02G	
Phenolic Water	03G	12.3
Rectisol		
Raw Gas	01R	7.3
Clean Gas	02R	7.4
H_2S Rich Stream	03R	7.1
Methanol	04R	7.8
Oily Water	05R	
Cyanic Water	06R	7.5
Naphtha	07R	7.6,15.3
Phenosolvan		
Phenolic Water	01P	12.3,13.12
Extracted Phenol	02P	14.6,15.4
Di-isopropyl ether(DIPE)	03P	14.10
DIPE/Water	04P	
Oily Water	05P	14.15
Tar	06P	15.1,13.10
Tar Separation		
Phenolic Water	01T	12.3,13.12
Expansion Gases	02T	3.4,13.5,13.6
Oil	03T	15.5,15.2,13.11
Tar	04T	15.1,13.10,13.8,13.9
Gas Condensate	05T	

APPENDIX D

DATA SHEET EXAMPLES

Date	Team	Unit	Source ID	Fitting	Stream	Height	Maximum Screening Concentrations (ppmv)							Repeat Code	Comment Code	Comments
							OVA	CO	NH_3	H_2S	$H_2S + SO_2$	RSH	CN			
1	5	6	7	11	13	16	17	23	29	34	39	44	47	50	52	54-89

Additional Comments: ______________________________

____

____

____

Figure D-1. Screening Data Sheet

SAMPLE IDENTIFICATION

CI 1 1 Date 2 Quality Control 6 Team 9

Unit 10 Source ID 11 Fitting Type 15

MAXIMUM RESCREENING VALUE BEFORE SAMPLE

OVA 17 Alternate Method: Code 23

Concentration 24

SAMPLE PARAMETERS

Flow Rate (cfm) 30 Temperature 1 (°C) 34 Temperature 2 (2°C) 37

Pressure 1 40 Pressure 2 44

Barometric Pressure (mm Hg) 48 Tent Pressure (in H_2O) 51

DGM Correction Factor 54 Inlet OVA 59 OVA # 62

Meter # ______________________________

Sample Comments 63 80

CI 2 1 NOTE TO KEYPUNCHER: Please duplicate information from columes 2-14 from above.

SAMPLE CONCENTRATIONS

1. OVA 15
2. CO 21
3. NH_3 27
4. H_2S 33
5. $H_2S + SO_2$ 38
6. RSH 43
7. CN 46

MAXIMUM RESCREENING VALUE AFTER SAMPLE

OVA 49 Alternate Method: Code 55 Concentration 56

Rescreening Comments 62 80

Figure D-2. Sampling Data Sheet

Stream Code	Stream Description

Figure D-3. Stream Code Sheet

Comment Code	Comment
1	3

Figure D-4. Comment Code Sheet

APPENDIX E
DATA HANDLING AND STATISTICAL PROCEDURES

E.1 DATA HANDLING

Data were taken on specially prepared data sheets and returned to the data management team at Radian. The data were manually edited in order to eliminate obvious anomalies and inconsistencies. The edited data were keypunched and key-verified. Programs using the SAS software system were used to input and perform a second edit on the data.

The following corrective changes were made to the screening and sampling data:

- Due to a calibration correction factor, dry gas meter readings in the sampling data were corrected. Depending on flow rate, the correction factors ranged from .99 to 1.02.
- All hydrocarbon concentration values were multiplied by a factor of 1.22. This corrected for the calibration gas analysis error that was mentioned in Section A.1 and is discussed in Appendix G.
- The leak rate sample analyses were adjusted to reflect the response factor for the OVA associated with the specific process fluid in the sample. Response factors ranged from 0.3 to 7.0.

E.2 STATISTICAL PROCEDURES

This section presents the statistical procedures applied in estimating emissions for unsampled sources and in developing emission factors for hydrocarbon emissions and their confidence intervals. The data obtained during the screening and sampling of baggable sources (pumps, valves, and flanges) was most conveniently grouped for analyses into two categories of process stream classifications (gas and liquid).

A brief presentation of the statistical analysis performed on the repeat screening data (components of variance) is also included.

E.2.1 Estimating Emissions for Nonsampled Sources

Due to time and equipment constraints, it was not always possible to sample all sources that screened greater than 50 ppm. In order not to bias the distribution of leaking sources, it was necessary to develop estimated values for all sources screening greater than 50 ppm and not sampled. Sources with screening values less than 50 ppm were assigned a leak rate equal to zero.

Least-squares regression analyses were done for each process stream group, regressing the logarithm of the measured leak rate on the logarithm of the screening value. Using the least-squares linear regression equations, predicted log-leak rates were computed for each source (not sampled) with a screening value greater than 50 ppm. Log-leak rates (kg/hr) were computed using:

$$\log_{10}(\text{leak rate}) = B_0+B_1 \log_{10} + Z \text{ (standard error of estimate)}$$

where B_0 is the least-squares intercept estimate

B_1 is the least-squares slope estimate, and is a random number from a standard-normal distribution

Z is a random number from a standard-normal distribution

The use of the random number is an attempt to yield a predicted distribution of leak rates which would approximate the distribution if all sources were sampled. These predicted $\log_{10}$ (leak rates) were used in further analyses and development of emission factors.

E.2.2 Development of Emission Factors

Estimated emission factors for hydrocarbon emissions for the two groups of process streams were developed using the statistical distribution models and properties for leak rates as set out in the EPA Refinery Fugitive Emissions project[1] and presented here.

A log-normal distribution was used to model the distribution of leaking sources. This distribution has the property that when the original data are transformed by taking natural logarithms, the transformed data will follow a normal distribution. The log-normal distribution is often appropriate when the standard error of an individual value is proportional to the magnitude of the value. The form of the log-normal distribution is as follows:

$$f(x) = \begin{cases} \dfrac{\exp\left[-\dfrac{(\ell n\ x - \mu)^2}{2\sigma^2}\right]}{x\sigma\sqrt{2\pi}} & \text{for } 0 < x < \infty \\ 0 & \text{for } x \leq 0 \end{cases}$$

$$\text{Mean} = \exp\left[\mu + \frac{\sigma^2}{2}\right]$$

$$\text{Variance} = \exp[2\mu + 2\sigma^2] - \exp[2\mu + \sigma^2]$$

In order to develop estimates for emission factors, the nonleaking sources (leak rate assumed equal to zero) also had to be modeled. A mixed distribution, specifically a log-normal distribution with a discrete probability mass at zero, was used for this purpose. Letting ρ equal the fraction of nonleaking sources in the population, this mixed log-normal distribution has the following form:

$$f(x) = \begin{cases} \dfrac{(1-\rho)\exp\left[-\dfrac{(\ell n\ x - \mu)^2}{2\sigma^2}\right]}{x\sigma\sqrt{2\pi}} & \text{for } 50 < x < \infty \\ \rho & \text{for } 0 \leq x \leq 50 \\ 0 & \text{for } x < 0 \end{cases}$$

$$\text{Mean} = (1-\rho)\exp\left[\mu + \frac{\sigma^2}{2}\right]$$

$$\text{Variance} = (1-\rho)\ [\exp(2\mu + \sigma^2)]\ [\exp(\sigma^2) - (1-\rho)]$$

Efficient estimates of the mean and variance of the population model by this mixed distribution have been developed [Finney[2] (1941), and Aitchison[3] (1955)]. These estimates are as follows:

The best, unbiased estimator of the population mean emission rate is

$$m = \left\{\left(1 - \frac{r}{n}\right)\exp\ (\bar{x})\quad g\left(\frac{s^2}{2}\right)\right\}$$

and the best, unbiased estimator of the population variance of the emission rates is

$$v = \left(1 - \frac{r}{n}\right)\exp(2\bar{x})\ \left[g(2s^2) - \left(1 - \frac{r}{n-1}\right) g\left(\frac{n-r-2}{n-r-1}\right)s^2\right]$$

where:

n = number of sources screened

r = number of sources screened <50 ppm

m = n - r = number of "leaking" sources

g(t) = infinite series

$$= 1 + \frac{(m-1)t}{m} + \frac{(m-1)^3 t^2}{m^2 2!\,(m+1)} + \frac{(m-1)^5 t^3}{m^3 3!(m+1)\,(m+3)} \cdots .$$

$\bar{x}$ = average of the logarithm of leaking sources

$$= \sum_{1}^{n-r} \ln \text{ (total hydrocarbon leaks)} / (n-r)$$

s^2 = variance of the logarithm of leaking sources

$$= \sum_{1}^{n-r} [\ln \text{ (total hydrocarbon leaks)} - \bar{x}]^2/(n-r-1)$$

The mean and variance formulas hold whenever there is more than one leaking source ($n - r > 1$). When only one leaking source is identified, the following estimates are appropriate:

$$\text{mean} = \frac{x_1}{n} \text{ and variance} = \frac{x_1^2}{n} ,$$

where x is the single measured leak. If no leaks are found ($r = n$), then the best estimate for both the mean and variance is zero.

E.2.3 Confidence Intervals for Percent Sources Leaking and for Emission Factors

Confidence intervals for the percent of leaking sources and for the emission factors were developed using binomial and lognormal distribution theory as was accomplished similarly in the Refinery project.[1]

The binominal is used to model data when a random sample is selected and each item is classified into one of two categories (leaking or nonleaking here). Exact confidence limits (level 1 - α) for the estimate of percent leaking can be obtained by iteration solving for P_ℓ in

$$\sum_{i=k}^{n} \binom{n}{i} P_\ell^{i} (1 - P_\ell)^{n-1} = \frac{\alpha}{2}$$

for the lower limit and for P_u in

$$\sum_{i=0}^{k} \binom{n}{i} P_u^{i} (1 - P_u)^{n-i} = \frac{\alpha}{2}$$

for the upper limit, where

n = number of sources screened

k = number of leaking sources.

Tables of these solutions, available for most cases, were used for computing 97.5 percent confidence intervals. The 97.5 percent was selected so that 95 percent confidence intervals for emission factors would result when the estimated percent leaking was combined with the estimated mean leak rate ($0.975 \times 0.975 \simeq 0.95$).

Patterson[4] (1966) described how confidence intervals for the mean from a lognormal distribution can be computed using estimators developed by Finney[2] (1941). The 97.5 percent confidence intervals were computed for the average, $\bar{y}$, of the transformed data, $y = n$ (leak), using

$$C_{\ell} = \text{lower limit} = \bar{y} - \left(2.24\ [s^2/(n-r)]^{1/2}\right)_p$$

and

$$C_u = \text{upper limit} = \bar{y} + \left(2.24\ [s^2/(n-r)]^{1/2}\right)_p$$

where

s^2 = the variance of the transformed data
$n - r$ = the number of leaking sources
p = percent of leak rates estimated.

Then, following Patterson's arguments, confidence intervals for the mean leak rate can be computed using:

$$C'_{\ell} = \text{lower limit} = \exp[C_{\ell}]\ g(s^2/2)$$

and

$$C'_u = \text{upper limit} = \exp[C_u]\ g(s^2/2)$$

where:

g(t) is the series given in Section A.2.2.

To obtain 95 percent confidence limits for the emission factors, the confidence limits for the percent leaking and for the mean leak rate were combined as follows:

lower 95% limit for emission factor = $P_{\ell}\ (\hat{C}_{\ell})$
upper 95% limit for emission factor = $P_u\ (\hat{C}_u)$

These confidence intervals are conservative in the sense that 95 percent is a lower bound for the confidence coefficient for the intervals. The confidence intervals should be interpreted as follows:

> When we state that the true emission factor falls within the limits computed as described above, we expect to be correct at least 95 percent of the time.

E.2.4 Variance Component Analysis

In order to investigate the variability of screening values from the same source over time, a variance component analysis was performed.

This involved first recognizing the type of relationship that exists between factors involved so that the appropriate analysis can be applied.

A variance component analysis was performed on the repeat screening data to determine the relative contributions to the variability of OVA screening values. The results of the analysis is summarized in Table E-1. The biggest contributor of variability is the difference between days within an individual component (∿71%). Approximately 26% of the total variability is due to the variability of repeat OVA readings within a day. Less than 3% of the total variability was due to the difference between valves. This relatively small percentage, however, was expected since the three valves chosen for repeat screening were selected because of their similarities. The variability associated with the difference in screening teams is less than 1 percent.

TABLE E-1. VARIANCE COMPONENTS

	Valves Ln (OVA Screening Value)		
Source of Variability	Degrees of Freedom	Variance Component Estimate	Percent*
TOTAL	85	1.163	100
Individual Valves	2	0.028	2.4
Team	1	0.004	0.3
Day (within a component)	39	0.826	71.0
Repeat (within a day)	43	0.305	26.2

*The percentage associated with a source of variability is 100 times the ratio of that source's estimated variance component to the total variance component.

The repeat screening data were classified according to individual valve, then within valves according to screening team and day, and finally, within day according to repeat readings.

And analysis of variance, which involves an arithmetic process for partitioning a total sum of squares into the components associated with recognized sources of variation, was then performed on the nested classification model.

The two sources of variation which contribute to the total variability of OVA screening values are:

1. The variation among OVA screening values treated alike, that is, among OVA screening values within days.

2. The variation among OVA screening values on different days treated alike, that is, variation among days within individual valves.

The variability of screening values from the same source over time was investigated by the performance of multiple screenings on the same source.

The components of variance given in Table E-1 are measures of these variations. Steel and Torrie[5] (1960) describe how variance components can be estimated for a nested classification design. An additional reference may be found in Rao[6] (1972).

E.3 REFERENCES FOR APPENDIX E

1. Radian Corporation. Assessment of Atmospheric Emissions from Petroleum Refining: Volume 4 - Appendix C, D, and E. EPA 600/2-80-075d. Austin, Texas 1980.

2. Finney, D.J. On the Distribution of a Variate Whose Logarithm is Normally Distributed. Journal of the Royal Statistical Society, Series B, 7:155-161, 1941.

3. Aitchison, J. On the Distribution of a Positive Random Variable Having a Discrete Probability Mass at the Origin. American Statistical Association Journal, 50(9):901-908. 1955.

4. Patterson, R.L. Difficulties Involved in the Estimation of a Population Mean Using Transformed Sample Data. Technometrics 8(3):535-537. 1966.

5. Steel, Robert G.D., and Torrie H. James. Principles and Procedures of Statistics. New York: McGraw-Hill Book Company, Inc. 1960.

6. Rao, C.R. Estimation of Variance and Covariance Components in Linear Models. Journal of the American Statistical Association, 57:112-115. 1972.

APPENDIX F
TECHNICAL AND RESPONSE FACTOR DATA

F.1 OVA TECHNICAL DATA

The specifications listed below (from Reference 1) apply to the Century Systems Organic Vapor Analyzer, Model OVA-108. This instrument was used for source screening and sample analysis during the Kosovo fugitive emissions testing.

TABLE F-1. OVA-108 SPECIFICATIONS

Detection principle: Flame ionization
Sensitivity: 1 ppmv (methane)
Response time: Less than 2 seconds
Readout: 250° logarithmic scale meter; 1 to 10,000 ppm
Sample flow rate: 1 liter per minute
Service life: Minimum 8 hours for hydrogen supply and rechargeable battery pack

The following memorandum and Table F-2 summarize the reproducibility that can be expected when using portable hydrocarbon detectors for fugitive emission screening. Additional data can be found in Reference 2.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE: 1/21/80

SUBJECT: Reproducibility of Leak Survey Results Using a Portable Hydrocarbon Analyzer

FROM: Winton Kelly, Field Testing Section WEK
Emission Measurement Branch, ESED (MD-13)

TO: K. C. Hustvedt, Petroleum Section
Chemical and Petroleum Branch, ESED (MD-13)

The results of testing performed during three EPA field studies to evaluate the repeatibility of leak detection are summarized in Table 1. The data show that VOC concentration readings in the ranges <200 ppm and >10000 ppm can be reproduced on the average, 98% and 90% of the time, respectively. For VOC readings between 200 and 10000 ppm, the reproducibility is significantly lower.

The average results represent a lumped reproducibility average. For Test 1, the repeat survey was performed by the same test crew using the same instrument on different days. For Test 2, the repeat survey was performed by a combination of different test crews, different instruments, and on different days. Test 3 represents the results of two test crews using different analyzers but performing the surveys at essentially the same time. All instruments used were Century Systems Model 108 Organic Vapor Analyzers.

The results of these tests have a direct impact on the selection of a leak definition concentration. From the data available, in order to confidently conclude 90% of the time whether or not a leak exists, the leak definition must be either 200 ppm, or 10,000 ppm.

The most probable causes for lower reproducibility at VOC concentration readings between 200 and 10000 ppm are the variations in technique between different test teams, the requirement that the repeat reading be made at exactly the same location, and the potential variability with time of the leak source.

I do not know of any additional specifications or procedures that could be added to the test method to improve the reproducibility for 200<VOC<10000 ppm, and still retain a practical, rapid survey technique.

Attachment

EPA FORM 1320-6 (REV. 3-76)

TABLE F-2. REPRODUCIBILITY SUMMARY, LEAK DETECTION USING PORTABLE ANALYZERS

	Test 1[a]				Test 2[b]				Test 3[c]				Total Data			
	Same Result		Different Result		Same Result		Different Result		Same Result		Different Result		Same Result		Different Result	
VOC Range	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
<200	135	98	3	2	77	85	14	15	1096	99	13	1	1308	98	30	2
201-1000	2	29	5	71	6	24	19	76	45	69	14	31	53	58	38	42
1001-10,000	8	57	6	43	11	44	14	56	53	66	18	34	72	65	38	35
>10,000	5	83	1	17	65	93	5	7	43	84	6	14	113	90	12	10

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[a] Dow Chemical, Placquemine, LA, EMB Report No. 78-OCM-12C

[b] Union Carbide, Torrance, CA, EMB Report No. 78-OCM-12A

[c] Sun Oil, Toledo, Ohio, EMB Report No. 78-OCM-12B

F.2 OVA RESPONSE FACTOR DATA

The OVA-108 instruments were calibrated with standards of methane in air. Some of the compounds present in Kosovo process streams produce a supressed or enhanced response on the OVA-108 detector. The following graphs (from Reference 3) show the experimental results of testing linearity of response of the OVA-108 to hexane, benzene, and methanol. Reference 3 also contains single point response data for a wide range of organic compounds. Based on the response factor data from Reference 3, a correction was applied to the leak sampling analysis for hydrocarbons. No response factor correction was applied to the screening data.

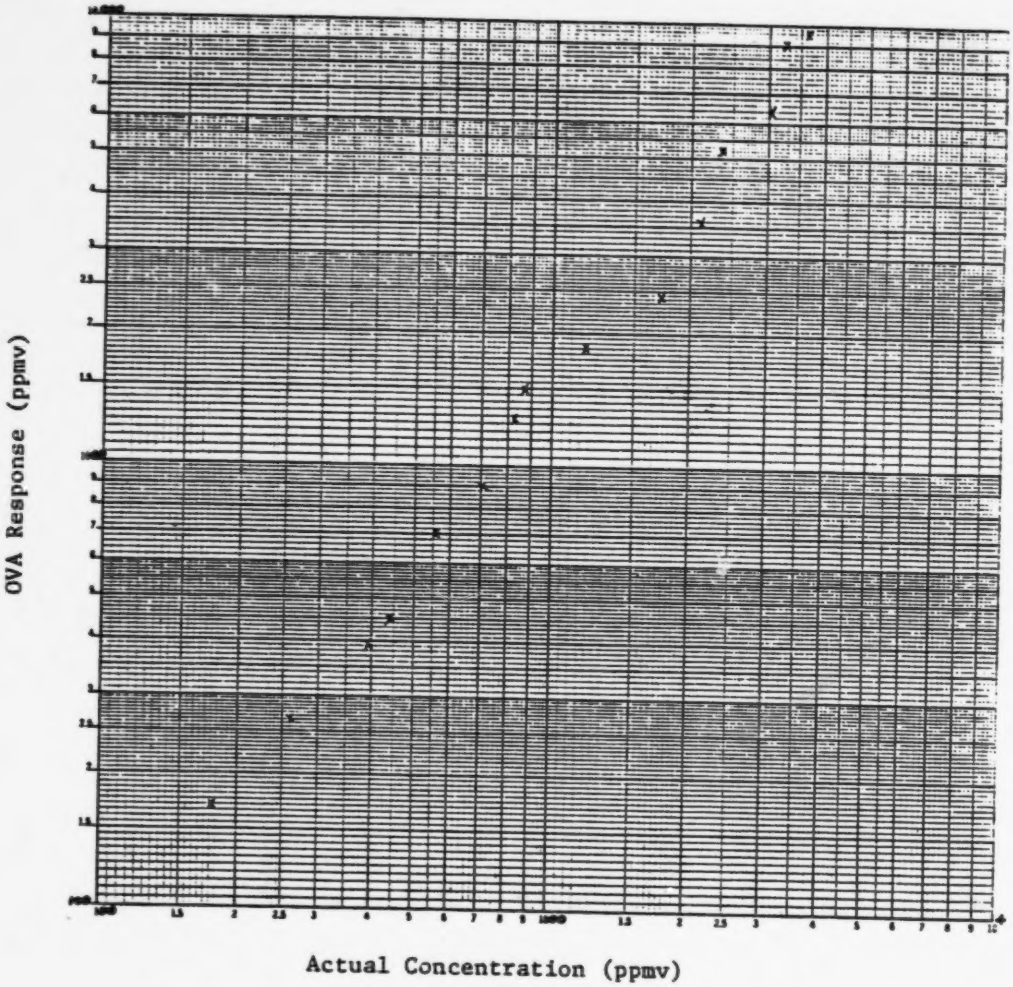


Figure F-1. Linearity of OVA Response to n-hexane

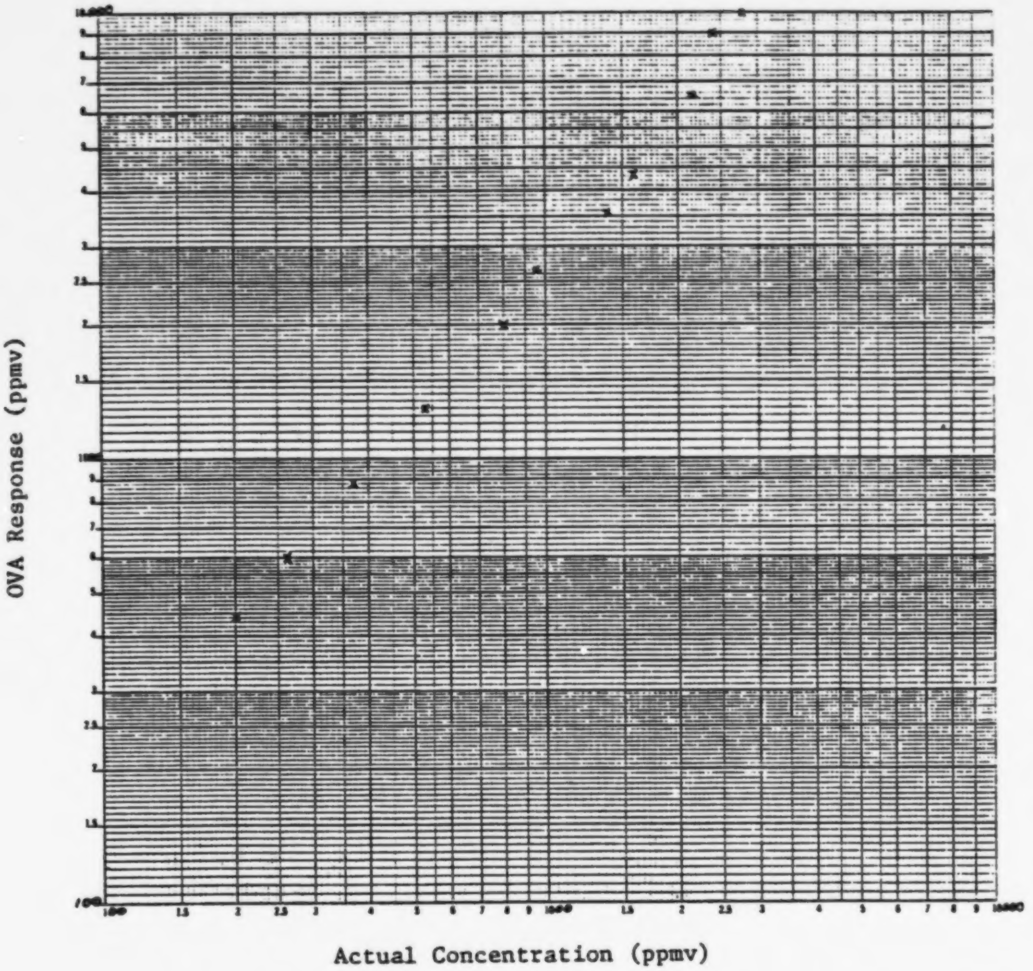


Figure F-2. Linearity of OVA Response to Benzene

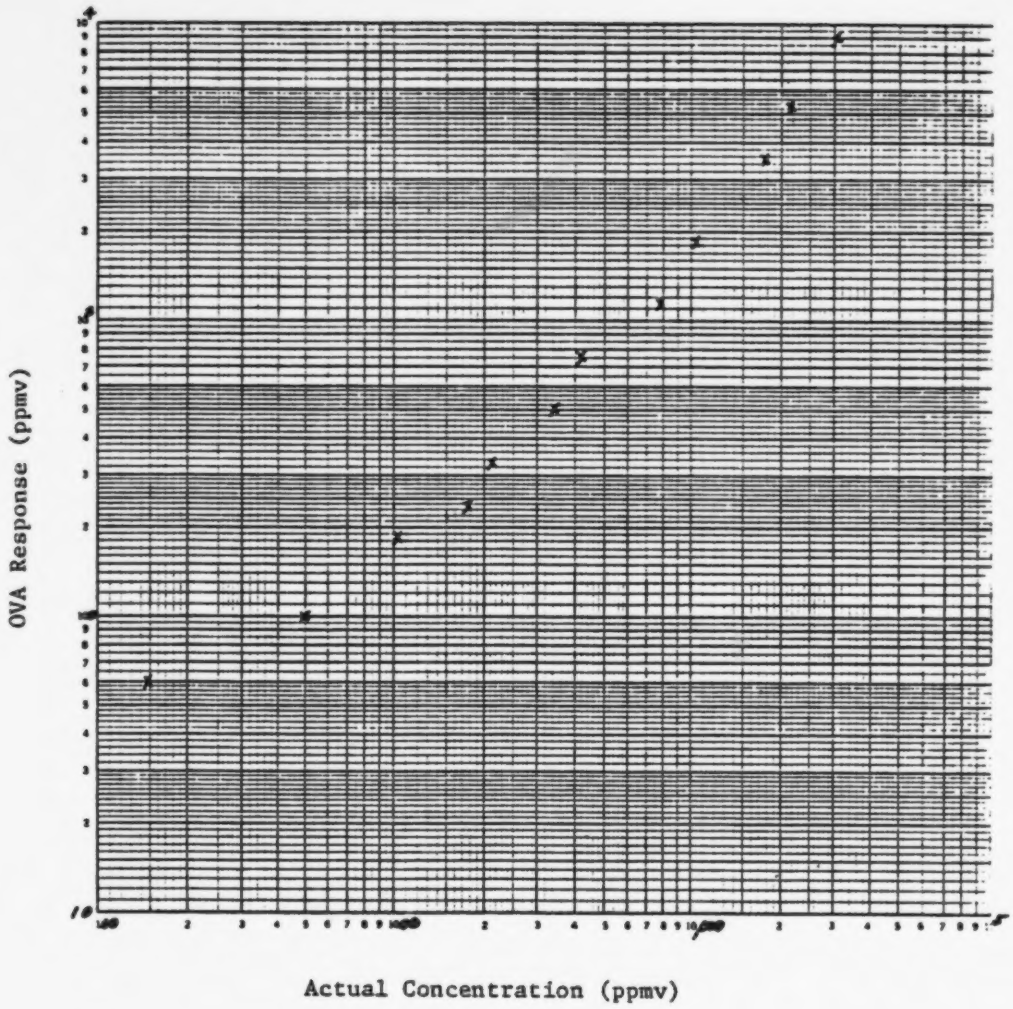


Figure F-3. Linearity of OVA Response to Methanol

F.3 DRAEGER® TUBE TECHNICAL DATA

Table F-3 shows the standard deviation that can be expected when using Draeger® tubes. For each type of tube, the standard deviations are shown for the start of the range of measurement and at the end of the range of measurement (from Reference 4).

TABLE F-3. DRAEGER® TUBE TECHNICAL DATA

Component Range Of Measurement	Standard Deviation at Start of Range (percent)	Standard Deviation at End of Range (percent)
Carbon Monoxide		
10 to 3000 ppmv	15	10
5000 to 70,000 ppmv	10	5
Ammonia		
5 to 70 ppmv	15	10
5000 to 100,000 ppmv	15	10
Hydrogen Sulfide		
100 to 2000 ppmv	10	5
2000 to 70,000 ppmv	10	5
Mercaptans		
2 to 100 ppmv	15	10
Hydrogen Cyanide		
2 to 30 ppmv	15	10

F.4 REFERENCES FOR APPENDIX F

1. Operating and Service Manual for Century Systems' Portable Organic Vapor Analyzer (OVA) Model OVA-108 and Optional Accessories. Century Systems Corporation. Analabs, North Haven, Connecticut.

2. Assessment of Atmospheric Emissions from Petroleum Refining, Volume 4. Austin, Texas. July 1980. EPA Report #600/2-80-075d.

3. G. E. Brown, D. A. DuBose, W. R. Phillips, G. E. Harris. Response Factors of VOC Analyzers Calibrated with Methane for Selected Organic Chemicals. Austin, Texas. September 1980. EPA Contract #68-02-3171.

4. Kurt Leichnitz. Detector Tube Handbook, Air Investigations and Technical Gas Analysis with Draeger Tubes. Dragerwerk Ag Lubeck, Germany. August 1976 (Third Edition).

APPENDIX G
CORRECTION FACTORS AND EXAMPLE CALCULATIONS

G.1 CALIBRATION GAS CORRECTION FACTOR

As described in Appendix E, the calibration gas supplied by INEP (4500 ppmv methane) was apparently analyzed incorrectly. The calibration gas brought from the U.S. (labeled 2016 ppmv methane) was analyzed after return to the U.S. The following memorandum summarizes the results of that analysis (a new bottle measured approximately 2030 ppmv methane). Because the OVA-108 analyzers were calibrated with the 4500 ppmv standard first, the 2016 ppmv standard gave a response of 1600 to 1700 ppmv (average = 1660). Therefore, all OVA data were corrected by multiplying by a factor of 2030/1660 = 1.22.

MEMORANDUM

DATE: September 12, 1980
TO: R. L. Honerkamp
FROM: A. L. Weilbacher alw
SUBJECT: Verification of Methane Levels in Calibration Gas

The analysis of calibration gas for methane levels has been completed. The contents of a used bottle and a new bottle were analyzed under the GC conditions listed below:

Instrument - Tracor Model 560 GC with flame ionization detector
Injector - 10 port Valco valve with 2.0 mL sample loop.
Column - 12' X 2 mm I.D. glass packed with Poropak N.
Temperature Program - 40°C to 170°C at 8°C/min with a 2 minute initial hold and a 25 minute final hold.
Standards - Lil' Squirt Calibrating Gases, Ideal Gas Products, Inc., with an analytical accuracy of ± 2%.

The samples were each analyzed in triplicate and were bracketed between two sets of standards. The standards employed in the analysis had methane concentrations of 95 ppm, 920 ppm, and 10,000 ppm by volume. The average methane concentration obtained for each of the sample bottles is presented below:

Parameter	Concentration (ppm)	
	Used Bottle	New Bottle
Methane	2083	2028

RCH:ml

cc: R. C. Hanisch
R. F. Moseman

Figure G-1. Calibration Gas Analysis

G.2 DRY GAS METER CORRECTION FACTOR

The two dry gas meters used in the leak sampling train were calibrated after return to the U.S. Figures G-2 and G-3 show the results of this calibration. Figure G-4 is a plot of the calibration data. Figure G-4 was used to apply the appropriate correction factor to the sampling data.

T AND M METER SERVICE
4109 LULLWOOD
AUSTIN, TEXAS 78722

GAS FLOW MEASUREMENT INSTRUMENTS - CALIBRATION

DRY GAS METER NO: 701025 **AND/OR ORIFCE NO: ____________

CALIBRATED BY: T&M DATE: 10/9/80

BAROMETRIC PRESSURE P_b = 29.31 in Hg

~~ORIFICE SETTING ΔH (in H_2O)~~ CFM	TEST METER VOLUME V_w (ft^3)	DRY GAS METER VOLUME V_d (ft^3)	TEMPERATURE				TIME Θ (min.)	DRY GAS METER γ	ORIFICE $\Delta H@$
			TEST METER T_w (^oF)	DRY GAS METER					
				INLET T_{di} (^oF)	OUTLET T_{do} (^oF)	AVG. T_d (^oF)			
.1	1	1.008	78	80.5	80	80.25	10	.9962	
.25	2	2.016	78	81.5	80	80.75	8	1.0005	
.50	5	5.030	78	83.5	79.5	81.5	10	1.0022	
.75	5	5.006	78	84	78.5	81.25	6.66	1.0041	
								1.0008	

$$\gamma = \frac{V_w\,(P_b + .11)(T_d + 460)}{V_d\,(P_b + \frac{\Delta H}{13.6})(T + 460)}$$

$$\Delta H@ = \frac{(0.0317)\ \Delta H}{P_b\ (T_{do} + 460)} \left[\frac{(T_w + 460)\ \Theta}{V_w}\right]^2$$

Figure G-2.

T AND M METER SERVICE
4109 LULLWOOD
AUSTIN, TEXAS 78722

GAS FLOW MEASUREMENT INSTRUMENTS - CALIBRATION

DRY GAS METER NO: 706947 **AND/OR ORIFCE NO: ______

CALIBRATED BY: T & M DATE: 10/9/80

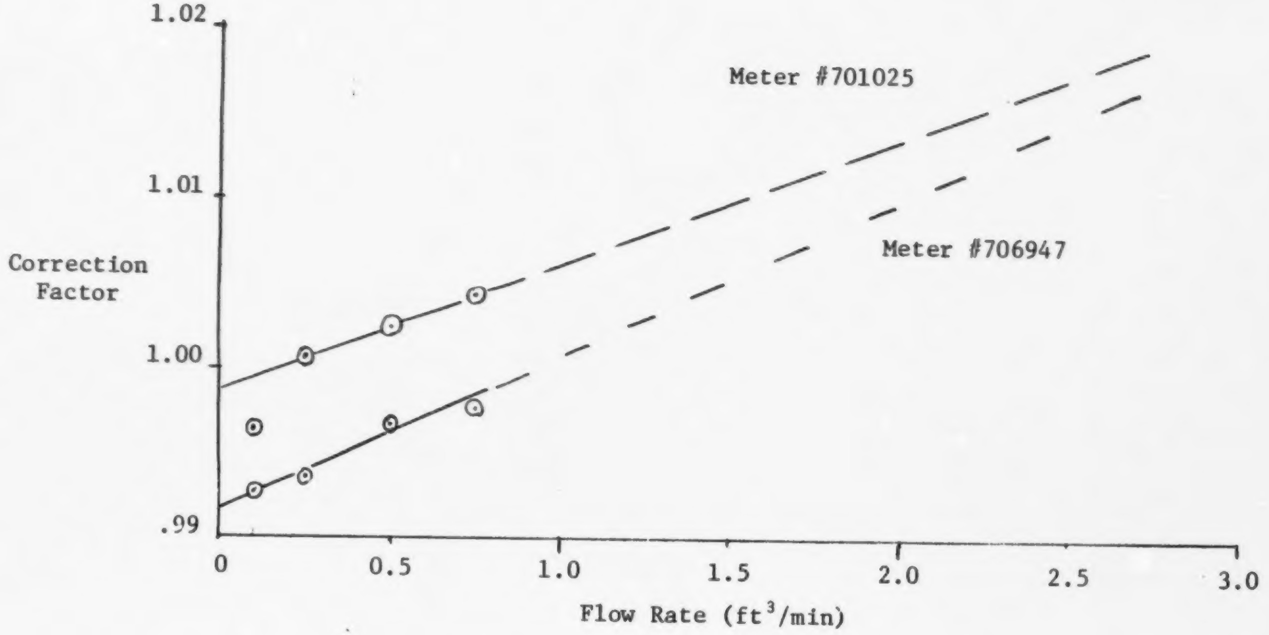
BAROMETRIC PRESSURE P_b = 29.31 in Hg

~~ORIFICE SETTING ΔH (in H_2O)~~ CFM	TEST METER VOLUME V_w (ft^3)	DRY GAS METER VOLUME V_d (ft^3)	TEMPERATURE				TIME Θ (min.)	DRY GAS METER Y	ORIFICE ΔH@
			TEST METER T_w (°F)	DRY GAS METER					
				INLET T_{di} (°F)	OUTLET T_{do} (°F)	AVG. T_d (°F)			
.1	1	1.005	77	76	75.5	75.75	10	.9927	
.25	2	2.015	77	76.5	75	75.75	8	.9936	
.50	5	5.015	77.5	77.5	75	76.25	10	.9964	
.75	5	5.000	77.5	77.5	75	76.25	6.66	.9970	
								.9949	

$$Y = \frac{V_w\ (P_b + .11)(T_d + 460)}{V_d\ (P_b + \frac{\Delta H}{13.6})(T\ \ + 460)}$$

$$\Delta H@ = \frac{(0.0317)\ \Delta H}{P_b\ (T_{do} + 460)} \left[\frac{(T_w + 460)\ \Theta}{V_w}\right]^2$$

Figure G-3.



(Correction factor) X (indicated flow) = actual flow

Figure G-4. Dry Gas Meter Correction Factor

G.3 EMISSION RATE EXAMPLE CALCULATION

The leak rate sampling data was used to calculate emission rates by applying the following equations.

G.3.1 Air Flow Rate to Leak Enclosure

$$FR = (DGM_f - DGM_i)(CF)(\bar{T}_{fi})(\bar{P}_{fi})/(t)$$

where:

FR = air flow rate (volume/time)

DGM = dry gas meter reading; initial, final (volume)

CF = dry gas meter correction factor (dimensionless)

$\bar{T}_{fi}$ = average meter temperature correction factor (dimensionless)

$\bar{P}_{fi}$ = average meter pressure correction factor (dimensionless)

t = duration of test (time)

G.3.2 Pollutant Concentration

$$C = (C_{out} - C_{in})(K)(RF)$$

where:

C = pollutant concentration (vol/vol)

C_{out} = pollutant concentration in sample bag (vol/vol)

C_{in} = pollutant concentration in air entering leak enclosure (vol/vol)

K = calibration gas correction factor (See Appendix E) = 1.22

RF = response factor of OVA-108 for pollutant (See Appendix F)

Note: For pollutants analyzed by Draeger® tubes, the pollutant concentration is the concentration measured on the sample bag; no corrections required.

G.3.3 Emission Rate

$$E = (FR)(C)/(V)$$

where:

E = pollutant emission rate (mass/time)

FR = air flow rate (volume/time)

C = pollutant concentration (vol/vol)

V = pollutant specific volume (volume/mass)

G.4 COMPARISON OF RELATIVE CONCENTRATIONS OF SPECIES IN SAMPLES TO RELATIVE CONCENTRATIONS OF SPECIES IN PROCESS STREAMS

During the sampling effort some data were taken (using Draeger® tubes) on species other than hydrocarbons (which were measured by OVA). These data may be found in Appendix H.5. Process stream data for the Kosovo plant have also been taken (Reference 1). Although these two data sources are not comprehensive with respect to streams within each processing unit, some comparison of the relative concentrations of species determined by these differing sampling and analysis methods can be made.

1. Hydrocarbon to CO ratio in desulfurized product gas - The following sampling data were obtained (ppmv):

HC	CO	HC/CO
428	500	0.9
20780	34000	0.6
6720	9000	0.8
208	310	0.7
611	500	1.2
134	80	1.7
2440	4000	0.6
2440	4000	0.6
611	700	0.9
2440	4000	0.6

The process data for the clean gas stream (Reference 1, sample point 7.4) yields the following:

HC = 162,000 ppmv CO = 220,000 ppmv
HC/CO = 162,000/220,000 = 0.7

The HC/CO ratios are similar. The leak mechanism does not appear to favor CO over HC, or visa versa.

2. Hydrocarbon to H_2S ratio in the vapors from internal aqueous/methanol streams in the Rectisol unit - The following sampling data were obtained (ppmv):

HC	H_2S	HC/H_2S
611	50	12
2688	200	13
147	10	15

Although not directly analagous, process data for the raw gas stream entering the Rectisol unit (Reference 1, sample point 7.3) yields the following:

HC = 120,000 ppmv H_2S = 6000 ppmv
HC/H_2S = 120,000/6000 = 20

The HC/H_2S ratio measured for the fugitive vapors is lower than that obtained for the raw gas. Definitive conclusions cannot be drawn, however, since no process data are available for the process streams at the point of sample. The difference in the ratios may be due to differences in the process composition (a greater portion of the raw gas hydrocarbon content has been absorbed at that point than the portion of raw gas H_2S content that has been absorbed) rather than a result of a leak mechanism which favors H_2S over hydrocarbons.

G.5 REFERENCES FOR APPENDIX G

1. Bombaugh, K. J., R. V. Collins, K. W. Lee, et al. Environmental Assessment: Source Test and Evaluation Report--Lurgi-Type (Kosovo, Yugoslavia) Medium-Btu Gasification. EPA Contract No. 68-02-3137 and 2177. Austin, Texas. Radian Corporation. August 1981.

APPENDIX H
RAW DATA LISTING

APPENDIX H.1
SCREENING DATA

RADIAN
CORPORATION

```
                                        KOSOVO SCREENING DATA          16:04 MONDAY, AUGUST 17, 1981     1

 ID    CCODE  MONTH  DAY  TEAM  UNIT  FIT  STREAM  HT        OVA  CO  NH3   H2S  STATE  CN  SCOM

1201            7    22    1     1    01   016     9        0.0   .    .     .    G     .
1203            7    22    1     1    01   016     9        0.0   .    .     .    G     .
1204            7    22    1     1    01   016     9        0.0   .    .     .    G     .
1206            7    22    1     1    01   016     9        0.0   .    .     .    G     .
1207            7    22    1     1    01   016     9        0.0   .    .     .    G     .
1208            7    22    1     1    01   016     9        0.0   .    .     .    G     .
1209            7    23    1     1    01   016     9        0.0   .    .     .    G     .
1212            7    23    1     1    01   016     9        0.0   .    .     .    G     .
1213            7    23    1     1    01   016     9        0.0   .    .     .    G     .
1214            7    23    1     1    01   016     9        0.0   .    .     .    G     .
1216            7    23    1     1    01   016     9        0.0   .    .     .    G     .
1217            7    23    1     1    01   016     9        0.0   .    .     .    G     .
1218            7    23    1     1    01   016     9        0.0   .    .     .    G     .
1219            7    23    1     1    01   016     9        0.0   .    .     .    G     .
1220            7    23    1     1    01   016     9        0.0   .    .     .    G     .
1902            7    22    1     1    01   016     9        0.0   .    .     .    G     .
1215            7    23    1     1    01   016     9       61.1   .    .     .    G     .
1205            7    22    1     1    01   016     9      366.7   .    .     .    G     .
1210    02      7    23    1     1    01   016     9     2444.4   .    .   150    G     .
1211    02      7    23    1     1    01   016     9    61111.1   .    .  7000    G     .
1159            7    22    1     1    03   016     9        0.0   .    .     .    G     .
1264            7    23    1     1    03   016     9        0.0   .    .     .    G     .
1198            7    22    1     1    03   016     5    85555.5   .    .   300    G     .
1151            7    22    1     1    10   016     9        0.0   .    .     .    G     .
1158            7    22    1     1    10   016     9        0.0   .    .     .    G     .
1162            7    22    1     1    10   016     9        0.0   .    .     .    G     .
1163            7    22    1     1    10   016     9        0.0   .    .     .    G     .
1164            7    22    1     1    10   016     9        0.0   .    .     .    G     .
1165            7    22    1     1    10   016     9        0.0   .    .     .    G     .
1166            7    22    1     1    10   016     9        0.0   .    .     .    G     .
1167            7    22    1     1    10   016     9        0.0   .    .     .    G     .
1168            7    22    1     1    10   016     9        0.0   .    .     .    G     .
1169            7    22    1     1    10   016     9        0.0   .    .     .    G     .
1170            7    22    1     1    10   016     9        0.0   .    .     .    G     .
1180            7    22    1     1    10   016     8        0.0   .    .     .    G     .
1181            7    22    1     1    10   016     9        0.0   .    .     .    G     .
1187            7    22    1     1    10   016     5        0.0   .    .     .    G     .
1188            7    22    1     1    10   016     5        0.0   .    .     .    G     .
1189            7    22    1     1    10   016     5        0.0   .    .     .    G     .
1190            7    22    1     1    10   016     5        0.0   .    .     .    G     .
1191            7    22    1     1    10   016     5        0.0   .    .     .    G     .
1193            7    22    1     1    10   016     5        0.0   .    .     .    G     .
1194            7    22    1     1    10   016     5        0.0   .    .     .    G     .
1195            7    22    1     1    10   016     5        0.0   .    .     .    G     .
```

RADIAN
CORPORATION

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                                                KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981     2

 ID   CCODE MONTH DAY TEAM UNIT FIT STREAM HT       OVA   CO NH3 H2S STATE CN                SCOM

1196          7   22    1    1   10   01G   5       0.0    .   .   .   G    .
1197          7   22    1    1   10   01G   5       0.0    .   .   .   G    .
1256          7   22    1    1   10   01G   5       0.0    .   .   .   G    .
1257          7   22    1    1   10   01G   5       0.0    .   .   .   G    .
1261          7   23    1    1   10   01G   9       0.0    .   .   .   G    .
1262          7   23    1    1   10   01G   9       0.0    .   .   .   G    .
1263          7   23    1    1   10   01G   9       0.0    .   .   .   G    .
1265          7   23    1    1   10   01G   9       0.0    .   .   .   G    .
1266          7   23    1    1   10   01G   9       0.0    .   .   .   G    .
1268          7   23    1    1   10   01G   9       0.0    .   .   .   G    .
1280          7   23    1    1   10   01G   9       0.0    .   .   .   G    .
1283          7   24    1    1   10   01G   9       0.0    .   .   .   G    .
1283          7   24    1    1   10   01G   9       0.0    .   .   .   G    .
1284          7   24    1    1   10   01G   9       0.0    .   .   .   G    .
1286          7   24    1    1   10   01G   9       0.0    .   .   .   G    .
1289          7   24    1    1   10   01G   9       0.0    .   .   .   G    .
1267          7   23    1    1   10   01G   9     110.0    .   .   .   G    .
1260          7   23    1    1   10   01G   9     244.4    .   .   .   G    .
1161   02     7   22    1    1   10   01G   9    2444.4 2500   . 800   G    .
1287          7   24    1    1   10   01G   9    8555.6    .   . 350   G    .
1258          7   23    1    1   10   01G   9   24444.4    .   . 700   G    .
1259          7   23    1    1   10   01G   9   24444.4    .   .   .   G    .
1179          7   22    1    1   11   01G   9       0.0    .   .   .   G    .
1183          7   22    1    1   11   01G   9       0.0    .   .   .   G    .
1192          7   22    1    1   11   01G   5       0.0    .   .   .   G    .
1199          7   22    1    1   11   01G   9       0.0    .   .   .   G    .
1200          7   22    1    1   11   01G   9       0.0    .   .   .   G    .
1182          7   22    1    1   11   01G   9    1344.4    .   . 100   G    .
1288          7   29    2    1   21   01G   9    2444.4  100   5  80   G    1   NOT SAMPLED.
1288          7   24    1    1   21   01G   9   14666.7    .   . 400   G    .
1221          7   22    1    1   01   03G   9       0.0    .   .   .   L    .
1222          7   22    1    1   01   03G   9       0.0    .   .   .   L    .
1223          7   22    1    1   01   03G   9       0.0    .   .   .   L    .
1224          7   22    1    1   01   03G   9       0.0    .   .   .   L    .
1225          7   22    1    1   01   03G   9       0.0    .   .   .   L    .
1226          7   22    1    1   01   03G   9       0.0    .   .   .   L    .
1227          7   22    1    1   01   03G   9       0.0    .   .   .   L    .
1228          7   22    1    1   01   03G   9       0.0    .   .   .   L    .
1229          7   22    1    1   01   03G   9       0.0    .   .   .   L    .
1230          7   22    1    1   01   03G   5       0.0    .   .   .   L    .
1231   02     7   22    1    1   01   03G   5       0.0    .   .   .   L    .
1232   02     7   22    1    1   01   03G   5       0.0    .   .   .   L    .
1233   02     7   22    1    1   01   03G   5       0.0    .   .   .   L    .
1234   02     7   22    1    1   01   03G   5       0.0    .   .   .   L    .
```

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                                             KOSOVO SCREENING DATA         16:04 MONDAY, AUGUST 17, 1981     3

 ID    CCODE  MONTH  DAY  TEAM  UNIT  FIT  STREAM  HT      OVA   CO  NH3  H2S  STATE  CN  SCOM

1235             7   22     1     1   01    036G    5    0.0000   .    .    .     L    .
1236             7   22     1     1   01    036G    5    0.0000   .    .    .     L    .
1237             7   22     1     1   01    036G    5    0.0000   .    .    .     L    .
1238             7   22     1     1   01    036G    5    0.0000   .    .    .     L    .
1239             7   22     1     1   01    036G    5    0.0000   .    .    .     L    .
1240             7   22     1     1   01    036G    5    0.0000   .    .    .     L    .
1173             7   22     1     1   03    036G    9    0.0000   .    .    .     L    .
1241             7   22     1     1   03    036G    9    0.0000   .    .    .     L    .
1279             7   23     1     1   03    036G    9    0.0000   .    .    .     L    .
1296    02       7   24     1     1   03    036G    8    0.0000   .    .    .     L    .
1297             7   24     1     1   03    036G    8    0.0000   .    .    .     L    .
1275             7   23     1     1   03    036G    9   36.6667   .    .    .     L    .
1152             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1153             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1154             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1155             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1156             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1157             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1160             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1171             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1172             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1175             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1176             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1176             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1177             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1178             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1243             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1244             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1245             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1246             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1247             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1248             7   22     1     1   10    036G    9    0.0000   .    .    .     L    .
1249             7   22     1     1   10    036G    5    0.0000   .    .    .     L    .
1250             7   22     1     1   10    036G    5    0.0000   .    .    .     L    .
1253             7   22     1     1   10    036G    5    0.0000   .    .    .     L    .
1254             7   22     1     1   10    036G    5    0.0000   .    .    .     L    .
1255             7   22     1     1   10    036G    5    0.0000   .    .    .     L    .
1269             7   23     1     1   10    036G    9    0.0000   .    .    .     L    .
1270             7   23     1     1   10    036G    9    0.0000   .    .    .     L    .
1271             7   23     1     1   10    036G    9    0.0000   .    .    .     L    .
1272             7   23     1     1   10    036G    9    0.0000   .    .    .     L    .
1273             7   23     1     1   10    036G    9    0.0000   .    .    .     L    .
1274    02       7   23     1     1   10    036G    9    0.0000   .    .    .     L    .
1276             7   23     1     1   10    036G    9    0.0000   .    .    .     L    .
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                                    KOSOVO SCREENING DATA       16:04 MONDAY, AUGUST 17, 1981     4

ID    CCODE  MONTH  DAY  TEAM  UNIT  FIT  STREAM  HT      OVA  CO  NH3  H2S  STATE  CN  SCOM

1277            7   23    1     1    10   03G     9      0.00   .    .    .    L     .
1278            7   23    1     1    10   03G     9      0.00   .    .    .    L     .
1281            7   24    1     1    10   03G     9      0.00   .    .    .    L     .
1282            7   24    1     1    10   03G     9      0.00   .    .    .    L     .
1290   02       7   24    1     1    10   03G     9      0.00   .    .    .    L     .
1291            7   24    1     1    10   03G     8      0.00   .    .    .    L     .
1292            7   24    1     1    10   03G     8      0.00   .    .    .    L     .
1293            7   24    1     1    10   03G     8      0.00   .    .    .    L     .
1295            7   24    1     1    10   03G     8      0.00   .    .    .    L     .
1298            7   24    1     1    10   03G     8      0.00   .    .    .    L     .
1299            7   24    1     1    10   03G     8      0.00   .    .    .    L     .
1300            7   24    1     1    10   03G     8      0.00   .    .    .    L     .
1301            7   24    1     1    10   03G     5      0.00   .    .    .    L     .
1302            7   24    1     1    10   03G     5      0.00   .    .    .    L     .
1303   02       7   24    1     1    10   03G     5      0.00   .    .    .    L     .
1306   02       7   24    1     1    10   03G     5      0.00   .    .    .    L     .
1307            7   24    1     1    10   03G     5      0.00   .    .    .    L     .
1251            7   22    1     1    10   03G     5    122.22   .    .    .    L     .
1252            7   22    1     1    10   03G     5    122.22   .    .    .    L     .
1294            7   24    1     1    10   03G     8   1100.00   .    .   50    L     .
1184            7   22    1     1    11   03G     5      0.00   .    .    .    L     .
1185            7   22    1     1    11   03G     5      0.00   .    .    .    L     .
1186            7   22    1     1    11   03G     5      0.00   .    .    .    L     .
1242            7   22    1     1    11   03G     9      0.00   .    .    .    L     .
1304   02       7   24    1     1    11   03G     5      0.00   .    .    .    L     .
1305   02       7   24    1     1    11   03G     5      0.00   .    .    .    L     .
1308            7   24    1     1    11   03G     5      0.00   .    .    .    L     .
1309   02       7   24    1     1    11   03G     5      0.00   .    .    .    L     .
1310   02       7   24    1     1    11   03G     5      0.00   .    .    .    L     .
1313            7   24    1     1    11   03G     5      0.00   .    .    .    L     .
1314            7   24    1     1    11   03G     5      0.00   .    .    .    L     .
1311   03       7   24    1     1    36   03G     5      0.00   .    .    .    L     .
1312   03       7   24    1     1    36   03G     5      0.00   .    .   50    L     .
1315   03       7   24    1     1    36   03G     5      0.00   .    .    .    L     .
1316   03       7   24    1     1    36   03G     5      0.00   .    .    .    L     .
1317   02       7   24    1     1    46   03G     0     73.33   .    .    .    L     .
1318   02       7   24    1     1    46   03G     0     73.33   .    .    .    L     .
943             7   17    1     2    01   01R     9      0.00   .    .    .    G     .
944             7   17    1     2    01   01R     9      0.00   .    .    .    G     .
951             7   17    1     2    01   01R     1      0.00   .    .    .    G     .
952             7   17    1     2    01   01R     1      0.00   .    .    .    G     .
953             7   17    1     2    01   01R     9      0.00   .    .    .    G     .
954             7   17    1     2    01   01R     9      0.00   .    .    .    G     .
12              7   11    1     2    10   01R     1      0.00   .    .    .    G     .
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                                  KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981     5

ID    CCODE  MONTH  DAY  TEAM  UNIT  FIT  STREAM  HT       OVA     CO   NH3  H2S  STATE  CN  SCOM

13             7    11    1     2    10    01R    8        0.0     .     .    .     G    .
15             7    11    1     2    10    01R    8        0.0     .     .    .     G    .
16             7    11    1     2    10    01R    8        0.0     .     .    .     G    .
17             7    11    1     2    10    01R    8        0.0     .     .    .     G    .
187            7    15    1     2    10    01R    9        0.0     .     .    .     G    .
188            7    15    1     2    10    01R    9        0.0     .     .    .     G    .
189            7    15    1     2    10    01R    9        0.0     .     .    .     G    .
19             7    11    1     2    10    01R    8        0.0     .     .    .     G    .
190            7    15    1     2    10    01R    9        0.0     .     .    .     G    .
192            7    15    1     2    10    01R    9        0.0     .     .    .     G    .
193            7    15    1     2    10    01R    9        0.0     .     .    .     G    .
20             7    11    1     2    10    01R    8        0.0     .     .    .     G    .
8              7    11    1     2    10    01R    1        0.0     .     .    .     G    .
85             7    12    1     2    10    01R    9        0.0     .     .    .     G    .
86             7    12    1     2    10    01R    9        0.0     .     .    .     G    .
9              7    11    1     2    10    01R    1        0.0     .     .    .     G    .
11             7    11    1     2    10    01R    1       30.6     .     .    .     G    .
420            7    15    2     2    11    01R    7        0.0     .     .    .     G    .
10             7    11    1     2    21    01R    1      550.0     .     .    .     G    .
14     01      7    11    1     2    21    01R    8    85555.5 18000     .    .     G    .
935            7    17    1     2    01    02R    9        0.0     .     .    .     G    .
936            7    17    1     2    01    02R    9        0.0     .     .    .     G    .
941            7    17    1     2    01    02R    9        0.0     .     .    .     G    .
942            7    17    1     2    01    02R    9     2444.4     .     .    0     G    .
36             7    11    1     2    03    02R    1    36666.7     .     .    .     G    .
191            7    15    1     2    10    02R    9        0.0     .     .    .     G    .
195            7    15    1     2    10    02R    9        0.0     .     .    .     G    .
33             7    11    1     2    10    02R    1        0.0     .     .    .     G    .
38             7    11    1     2    10    02R    1        0.0     .     .    .     G    .
39             7    11    1     2    10    02R    1        0.0     .     .    .     G    .
40             7    11    1     2    10    02R    2        0.0     .     .    .     G    .
41             7    11    1     2    10    02R    2        0.0     .     .    .     G    .
419            7    15    2     2    10    02R    7        0.0     .     .    .     G    .
42             7    11    1     2    10    02R    2        0.0     .     .    .     G    .
422            7    15    2     2    10    02R    7        0.0     .     .    .     G    .
43             7    11    1     2    10    02R    2        0.0     .     .    .     G    .
45             7    11    1     2    10    02R    1        0.0     .     .    .     G    .
46             7    11    1     2    10    02R    2        0.0     .     .    .     G    .
47             7    11    1     2    10    02R    2        0.0     .     .    .     G    .
48             7    11    1     2    10    02R    2        0.0     .     .    .     G    .
50             7    11    1     2    10    02R    2        0.0     .     .    .     G    .
53             7    11    1     2    10    02R    1        0.0     .     .    .     G    .
54             7    11    1     2    10    02R    1        0.0     .     .    .     G    .
55             7    11    1     2    10    02R    1        0.0     .     .    .     G    .
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                                  KOSOVO SCREENING DATA       16:04 MONDAY, AUGUST 17, 1981    6

ID    CCODE  MONTH  DAY  TEAM  UNIT  FIT  STREAM  HT      OVA     CO  NH3  H2S  STATE  CN  SCOM

59               7   11     1     2   10    02R    1        0      .    .    .    G     .
60               7   11     1     2   10    02R    2        0      .    .    .    G     .
61               7   11     1     2   10    02R    2        0      .    .    .    G     .
65               7   12     1     2   10    02R    9        0      .    .    .    G     .
83               7   12     1     2   10    02R    9        0      .    .    .    G     .
421              7   15     2     2   10    02R    7       86      .    .    .    G     .
34               7   11     1     2   10    02R    1      122      .    .    .    G     .
49               7   11     1     2   10    02R    2      122      .    .    .    G     .
88               7   12     1     2   10    02R    9      367      .    .    .    G     .
87               7   12     1     2   10    02R    9     1222   1800    .    .    G     .
57               7   11     1     2   10    02R    1     3667    250    .    .    G     .
82               7   12     1     2   10    02R    9     3667   1800    .    .    G     .
44               7   12     1     2   10    02R    1     6111   3000    .    .    G     .
56               7   12     1     2   10    02R    1     8556   9000    .    .    G     .
63               7   12     1     2   10    02R    9    24444   1500    .    .    G     .
37               7   12     1     2   10    02R    1    36667  12000    .    .    G     .
51               7   11     1     2   10    02R    1   122222  45000    .    .    G     .
32               7   11     1     2   10    02R    8   122223  15000    .    .    G     .
35               7   11     1     2   10    02R    1   122223      .    .    .    G     .
52               7   11     1     2   11    02R    1        0      .    .    .    G     .
58               7   11     1     2   11    02R    1        0      .    .    .    G     .
416              7   15     2     2   12    02R    7        0      .    .    .    G     .
417              7   15     2     2   12    02R    7        0      .    .    .    G     .
418              7   15     2     2   12    02R    7        0      .    .    .    G     .
66               7   12     1     2   21    02R    9        0      .    .    .    G     .
62               7   12     1     2   21    02R    9   122223  16000    .    .    G     .
64               7   12     1     2   21    02R    9   122223  18000    .    .    G     .
937              7   17     1     2   01    03R    9        0      .    .    .    G     .
938              7   17     1     2   01    03R    9        0      .    .    .    G     .
939              7   17     1     2   01    03R    9        0      .    .    .    G     .
945              7   17     1     2   01    03R    9        0      .    .    .    G     .
946              7   17     1     2   01    03R    9        0      .    .    .    G     .
947              7   17     1     2   01    03R    9        0      .    .    .    G     .
948              7   17     1     2   01    03R    9        0      .    .    .    G     .
949              7   17     1     2   01    03R    9        0      .    .    .    G     .
950              7   17     1     2   01    03R    9        0      .    .    .    G     .
940              7   17     1     2   03    03R    9        0      .    .    .    G     .
198              7   15     1     2   04    03R    9        0      .    .    .    G     .
123              7   15     2     2   10    03R    7        0      .    .    .    G     .
18               7   11     1     2   10    03R    8        0      .    .    .    G     .
194              7   15     1     2   10    03R    9        0      .    .    .    G     .
204              7   15     1     2   10    03R    8        0      .    .    .    G     .
21               7   11     1     2   10    03R    8        0      .    .    .    G     .
23               7   11     1     2   10    03R    8        0      .    .    .    G     .
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KOSOVO SCREENING DATA 16:04 MONDAY, AUGUST 17, 1981 7

ID	CCODE	MONTH	DAY	TEAM	UNIT	FIT	STREAM	HT	OVA	CO	NH3	H2S	STATF	CN	SCOM
28		7	11	1	2	10	03R	8	0.000	.	.	.	G	.	
29		7	11	1	2	10	03R	8	0.000	.	.	.	G	.	
413		7	15	2	2	10	03R	9	0.000	.	.	.	G	.	
67		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
68		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
70		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
71		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
72		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
73		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
74		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
76		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
77		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
78		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
79		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
80		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
84		7	12	1	2	10	03R	9	0.000	.	.	.	G	.	
25		7	11	1	2	10	03R	8	171.111	.	.	0	G	.	
26		7	11	1	2	11	03R	8	0.000	.	.	.	G	.	
30		7	11	1	2	11	03R	8	0.000	.	.	.	G	.	
31		7	11	1	2	11	03R	8	0.000	.	.	.	G	.	
432		7	15	2	2	11	03R	7	0.000	.	.	.	G	.	
24		7	11	1	2	11	03R	8	73.333	.	.	.	G	.	
27		7	11	1	2	11	03R	8	122.222	.	.	.	G	.	
199		7	15	1	2	12	03R	9	0.000	.	.	.	G	.	
424		7	15	2	2	12	03R	7	0.000	.	.	.	G	.	
412		7	15	2	2	14	03R	9	0.000	.	.	.	G	.	
415		7	15	2	2	14	03R	9	0.000	.	.	.	G	.	
414		7	15	2	2	14	03R	9	24.444	.	.	.	G	.	
69		7	12	1	2	20	03R	9	0.000	.	.	.	G	.	
75		7	12	1	2	21	03R	9	0.000	.	.	.	G	.	
81		7	12	1	2	21	03R	9	0.000	.	.	.	G	.	
22		7	11	1	2	21	03R	8	158.889	.	.	60	G	.	
629		7	17	2	2	01	04R	1	0.000	.	.	.	L	.	
630		7	17	2	2	01	04R	1	0.000	.	.	.	L	.	
631		7	17	2	2	01	04R	1	0.000	.	.	.	L	.	
632		7	17	2	2	01	04R	1	0.000	.	.	.	L	.	
633		7	17	2	2	01	04R	1	0.000	.	.	.	L	.	
635		7	17	2	2	01	04R	1	0.000	.	.	.	L	.	
636		7	17	2	2	01	04R	1	0.000	.	.	.	L	.	
955		7	17	1	2	01	04R	1	0.000	.	.	.	L	.	
957		7	17	1	2	01	04R	0	0.000	.	.	.	L	.	
958		7	17	1	2	01	04R	0	0.000	.	.	.	L	.	
959		7	17	1	2	01	04R	1	0.000	.	.	.	L	.	
960		7	17	1	2	01	04R	1	0.000	.	.	.	L	.	

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                                        KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981     8
ID    CCODE MONTH DAY TEAM UNIT FIT STREAM HT      OVA CO NH3 H2S STATE CN SCOM

961           7    17   1    2   01   04R   1      0.0 .   .   .    L   .
956           7    17   1    2   01   04R   0    305.6 .   .   .    L   .
634           7    17   2    2   01   04R   1   2444.4 .   .  180   L   .
211           7    15   1    2   03   04R   1      0.0 .   .   .    L   .
452           7    15   2    2   03   04R   1      0.0 .   .   .    L   .
455           7    15   2    2   03   04R   1      0.0 .   .   .    L   .
585           7    16   2    2   03   04R   1      0.0 .   .   .    L   .
807           7    16   1    2   03   04R   1      0.0 .   .   .    L   .
810           7    16   1    2   03   04R   1      0.0 .   .   .    L   .
819           7    16   1    2   03   04R   1      0.0 .   .   .    L   .
519           7    16   2    2   03   04R   1     24.4 .   .   .    L   .
218           7    15   1    2   03   04R   1    122.2 .   .   .    L   .
599           7    16   2    2   03   04R   1    122.2 .   .   .    L   .
845           7    16   1    2   03   04R   1    146.7 .   .   .    L   .
520           7    16   2    2   03   04R   1    183.3 .   .   .    L   .
857           7    16   1    2   03   04R   0    244.4 .   .   .    L   .
875           7    16   1    2   03   04R   0    244.4 .   .   .    L   .  6 DROP/MIN
876           7    16   1    2   03   04R   0    244.4 .   .   .    L   .  60 DROP/MIN
814           7    16   1    2   03   04R   1    366.7 .   .   .    L   .
823           7    16   1    2   03   04R   1    366.7 .   .   .    L   .
836   02      7    16   1    2   03   04R   1   1222.2 .   .   .    L   .  60 DROP/MIN
1147  02      7    21   1    2   03   04R   5   6111.1 .   .  150   L   .
444   02      7    15   2    2   03   04R   1   6111.1 .   .   0    L   .
570   02      7    16   2    2   03   04R   1   8555.6 .   .  100   L   .
866           7    16   1    2   03   04R   0   8555.6 .   .   .    L   .  MINIMAL GAS LEAK.STILL PIT
574   02      7    16   2    2   03   04R   1  24444.4 .   .  100   L   .
592           7    16   2    2   03   04R   1  24444.4 .   .   0    L   .
1134          7    21   1    2   10   04R   3      0.0 .   .   .    G   .
1135          7    21   1    2   10   04R   3      0.0 .   .   .    L   .
1136          7    21   1    2   10   04R   3      0.0 .   .   .    L   .
1137          7    21   1    2   10   04R   3      0.0 .   .   .    L   .
1138          7    21   1    2   10   04R   3      0.0 .   .   .    L   .
1139          7    21   1    2   10   04R   3      0.0 .   .   .    L   .
1140          7    21   1    2   10   04R   3      0.0 .   .   .    L   .
1141          7    21   1    2   10   04R   5      0.0 .   .   .    L   .
1142          7    21   1    2   10   04R   5      0.0 .   .   .    L   .
1143          7    21   1    2   10   04R   5      0.0 .   .   .    L   .
1144          7    21   1    2   10   04R   5      0.0 .   .   .    L   .
1145          7    21   1    2   10   04R   5      0.0 .   .   .    G   .
1146          7    21   1    2   10   04R   5      0.0 .   .   .    L   .
1148          7    21   1    2   10   04R   5      0.0 .   .   .    G   .
1149          7    21   1    2   10   04R   5      0.0 .   .   .    L   .
1150          7    21   1    2   10   04R   5      0.0 .   .   .    L   .
200           7    15   1    2   10   04R   9      0.0 .   .   .    L   .
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                                                 KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981     9
 ID    CCODF   MONTH   DAY   TEAM   UNIT   FIT   STREAM   HT   OVA   CO   NH3   H2S   STATE   CN   SCON

201              7     15     1      2     10     04R     8     0    .     .     .      L     .
202              7     15     1      2     10     04R     8     0    .     .     .      L     .
203              7     15     1      2     10     04R     8     0    .     .     .      L     .
206              7     15     1      2     10     04R     2     0    .     .     .      L     .
207              7     15     1      2     10     04R     2     0    .     .     .      L     .
208              7     15     1      2     10     04R     2     0    .     .     .      L     .
210              7     15     1      2     10     04R     1     0    .     .     .      L     .
215              7     15     1      2     10     04R     1     0    .     .     .      L     .
216              7     15     1      2     10     04R     1     0    .     .     .      L     .
217              7     15     1      2     10     04R     1     0    .     .     .      L     .
219              7     15     1      2     10     04R     1     0    .     .     .      L     .
220              7     15     1      2     10     04R     1     0    .     .     .      L     .
221              7     15     1      2     10     04R     2     0    .     .     .      L     .
222              7     15     1      2     10     04R     2     0    .     .     .      L     .
223              7     15     1      2     10     04R     1     0    .     .     .      L     .
228              7     15     1      2     10     04R     1     0    .     .     .      L     .
230              7     15     1      2     10     04R     1     0    .     .     .      L     .
441              7     15     2      2     10     04R     1     0    .     .     .      L     .
442              7     15     2      2     10     04R     1     0    .     .     .      L     .
443              7     15     2      2     10     04R     1     0    .     .     .      L     .
445              7     15     2      2     10     04R     1     0    .     .     .      L     .
446              7     15     2      2     10     04R     1     0    .     .     .      L     .
447              7     15     2      2     10     04R     1     0    .     .     .      L     .
448              7     15     2      2     10     04R     1     0    .     .     .      L     .
456              7     15     2      2     10     04R     1     0    .     .     .      L     .
457              7     15     2      2     10     04R     1     0    .     .     .      L     .
458              7     15     2      2     10     04R     1     0    .     .     .      L     .
459              7     15     2      2     10     04R     1     0    .     .     .      L     .
460              7     15     2      2     10     04R     1     0    .     .     .      L     .
461              7     15     2      2     10     04R     1     0    .     .     .      L     .
462              7     15     2      2     10     04R     1     0    .     .     .      L     .
463              7     15     2      2     10     04R     1     0    .     .     .      L     .
470              7     15     2      2     10     04R     1     0    .     .     .      L     .
471              7     15     2      2     10     04R     1     0    .     .     0      L     .
477              7     15     2      2     10     04R     1     0    .     .     .      L     .
484              7     15     2      2     10     04R     1     0    .     .     .      L     .
485              7     15     2      2     10     04R     1     0    .     .     .      L     .
490              7     15     2      2     10     04R     1     0    .     .     .      L     .
494              7     16     2      2     10     04R     1     0    .     .     .      L     .
495              7     16     2      2     10     04R     1     0    .     .     .      L     .
496              7     16     2      2     10     04R     1     0    .     .     .      L     .
497              7     16     2      2     10     04R     1     0    .     .     .      L     .
498              7     16     2      2     10     04R     1     0    .     .     .      L     .
499              7     16     2      2     10     04R     1     0    .     .     .      L     .
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KOSOVO SCREENING DATA 16:04 MONDAY, AUGUST 17, 1981 10

ID	CCODE	MONTH	DAY	TEAM	UNIT	FIT	STREAM	HT	OVA	CO	NH3	H2S	STATE	CN	SCOM
500		7	16	2	2	10	04R	1	0	.	.	.	L	.	
501		7	16	2	2	10	04R	1	0	.	.	.	L	.	
502		7	16	2	2	10	04R	1	0	.	.	.	L	.	
503		7	16	2	2	10	04R	1	0	.	.	.	L	.	
504		7	16	2	2	10	04R	1	0	.	.	.	L	.	
505		7	16	2	2	10	04R	1	0	.	.	.	L	.	
529		7	16	2	2	10	04R	1	0	.	.	.	L	.	
531		7	16	2	2	10	04R	1	0	.	.	.	L	.	
532		7	16	2	2	10	04R	1	0	.	.	.	L	.	
533		7	16	2	2	10	04R	1	0	.	.	.	L	.	
534		7	16	2	2	10	04R	1	0	.	.	.	L	.	
535		7	16	2	2	10	04R	1	0	.	.	.	L	.	
536		7	16	2	2	10	04R	1	0	.	.	.	L	.	
537		7	16	2	2	10	04R	1	0	.	.	.	L	.	
538		7	16	2	2	10	04R	1	0	.	.	.	L	.	
559		7	16	2	2	10	04R	1	0	.	.	.	L	.	
561		7	16	2	2	10	04R	1	0	.	.	.	L	.	
562		7	16	2	2	10	04R	1	0	.	.	.	L	.	
563		7	16	2	2	10	04R	1	0	.	.	.	L	.	
564		7	16	2	2	10	04R	1	0	.	.	.	L	.	
565		7	16	2	2	10	04R	1	0	.	.	.	L	.	
566		7	16	2	2	10	04R	1	0	.	.	.	L	.	
567		7	16	2	2	10	04R	1	0	.	.	.	L	.	
571		7	16	2	2	10	04R	1	0	.	.	.	L	.	
572		7	16	2	2	10	04R	1	0	.	.	.	L	.	
575		7	16	2	2	10	04R	1	0	.	.	.	L	.	
576		7	16	2	2	10	04R	1	0	.	.	.	L	.	
577		7	16	2	2	10	04R	1	0	.	.	.	L	.	
578		7	16	2	2	10	04R	1	0	.	.	.	L	.	
579		7	16	2	2	10	04R	1	0	.	.	.	L	.	
580		7	16	2	2	10	04R	1	0	.	.	.	L	.	
581		7	16	2	2	10	04R	1	0	.	.	.	L	.	
584		7	16	2	2	10	04R	1	0	.	.	.	L	.	
586		7	16	2	2	10	04R	1	0	.	.	.	L	.	
587		7	16	2	2	10	04R	1	0	.	.	.	L	.	
588		7	16	2	2	10	04R	1	0	.	.	.	L	.	
589		7	16	2	2	10	04R	1	0	.	.	.	L	.	
590		7	16	2	2	10	04R	1	0	.	.	.	L	.	
591		7	16	2	2	10	04R	1	0	.	.	.	L	.	
593		7	16	2	2	10	04R	1	0	.	.	.	L	.	
594		7	16	2	2	10	04R	1	0	.	.	.	L	.	
595		7	16	2	2	10	04R	1	0	.	.	.	L	.	
596		7	16	2	2	10	04R	1	0	.	.	.	L	.	
597		7	16	2	2	10	04R	1	0	.	.	.	L	.	

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                                      KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981   11
ID   CCODE  MONTH  DAY  TEAM  UNIT  FIT  STREAM  HT  OVA  CO  NH3  H2S  STATE  CN  SCOM

598           7    16    2     2    10    04R    1    0   .    .    .     L     .
804           7    16    1     2    10    04R    0    0   .    .    .     L     .
805           7    16    1     2    10    04R    0    0   .    .    .     L     .
808           7    16    1     2    10    04R    2    0   .    .    .     L     .
811           7    16    1     2    10    04R    1    0   .    .    .     L     .
812           7    16    1     2    10    04R    2    0   .    .    .     L     .
813           7    16    1     2    10    04R    1    0   .    .    .     L     .
815           7    16    1     2    10    04R    2    0   .    .    .     L     .
816           7    16    1     2    10    04R    1    0   .    .    .     L     .
817           7    16    1     2    10    04R    1    0   .    .    .     L     .
818           7    16    1     2    10    04R    1    0   .    .    .     L     .
820           7    16    1     2    10    04R    1    0   .    .    .     L     .
821           7    16    1     2    10    04R    1    0   .    .    .     L     .
822           7    16    1     2    10    04R    1    0   .    .    .     L     .
824           7    16    1     2    10    04R    2    0   .    .    .     L     .
833           7    16    1     2    10    04R    1    0   .    .    .     L     .
835           7    16    1     2    10    04R    1    0   .    .    .     L     .
837           7    16    1     2    10    04R    2    0   .    .    .     L     .
838           7    16    1     2    10    04R    2    0   .    .    .     L     .
839           7    16    1     2    10    04R    2    0   .    .    .     L     .
840           7    16    1     2    10    04R    1    0   .    .    .     L     .
842           7    16    1     2    10    04R    1    0   .    .    .     L     .
843           7    16    1     2    10    04R    1    0   .    .    .     L     .
844           7    16    1     2    10    04R    1    0   .    .    .     L     .
846           7    16    1     2    10    04R    1    0   .    .    .     L     .
847           7    16    1     2    10    04R    1    0   .    .    .     L     .
848           7    16    1     2    10    04R    1    0   .    .    .     L     .
850           7    16    1     2    10    04R    1    0   .    .    .     L     .
851           7    16    1     2    10    04R    1    0   .    .    .     L     .
852           7    16    1     2    10    04R    1    0   .    .    .     G     .
853           7    16    1     2    10    04R    1    0   .    .    .     G     .
854           7    16    1     2    10    04R    0    0   .    .    .     G     .
855           7    16    1     2    10    04R    0    0   .    .    .     L     .
856           7    16    1     2    10    04R    0    0   .    .    .     L     .
858           7    16    1     2    10    04R    0    0   .    .    .     L     .
860           7    16    1     2    10    04R    0    0   .    .    .     L     .
863           7    16    1     2    10    04R    0    0   .    .    .     L     .
864           7    16    1     2    10    04R    0    0   .    .    .     L     .
865           7    16    1     2    10    04R    0    0   .    .    .     L     .
870           7    16    1     2    10    04R    0    0   .    .    .     L     .
871           7    16    1     2    10    04R    0    0   .    .    .     L     .
872           7    16    1     2    10    04P    0    0   .    .    .     L     .
874           7    16    1     2    10    04R    0    0   .    .    .     L     .
877           7    16    1     2    10    04R    0    0   .    .    .     L     .
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                                          KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981   12

 ID  CCODE MONTH DAY TEAM UNIT FIT STREAM HT      OVA CO NH3  H2S STATE CN SCOM

 878           7   16   1    2   10   04R  0      0.0 .   .    .    L   .
 560           7   16   2    2   10   04R  1     24.4 .   .    .    L   .
 209           7   15   1    2   10   04R  1     48.9 .   .    .    L   .
 493           7   16   2    2   10   04R  1     61.1 .   .    .    L   .
 212           7   15   1    2   10   04R  1     73.3 .   .    .    L   .
 478           7   15   2    2   10   04R  1     73.3 .   .    .    L   .
 214           7   15   1    2   10   04R  1     85.6 .   .    0    L   .
 196           7   15   1    2   10   04R  8    122.2 .   .    .    L   .
 476           7   15   2    2   10   04R  1    122.2 .   .    .    L   .
 479           7   15   2    2   10   04R  1    122.2 .   .    0    L   .
 582           7   16   2    2   10   04R  1    122.2 .   .    0    L   .
 583           7   16   2    2   10   04R  1    122.2 .   .    .    L   .
 226           7   15   1    2   10   04R  2    183.3 .   .    .    L   .
 480           7   15   2    2   10   04R  1    183.3 .   .    .    L   .
 569           7   16   2    2   10   04R  1    183.3 .   .    .    L   .
 466           7   15   2    2   10   04R  1    244.4 .   .    .    L   .
 467           7   15   2    2   10   04R  1    244.4 .   .    0    L   .
 492           7   16   2    2   10   04R  1    244.4 .   .    0    L   .
 573           7   16   2    2   10   04R  1    244.4 .   .    0    L   .
 841           7   16   1    2   10   04R  1    244.4 .   .    .    L   .
 859           7   16   1    2   10   04R  0    244.4 .   .    .    L   .
 861           7   16   1    2   10   04R  0    244.4 .   .    .    L   .
 469           7   15   2    2   10   04R  1    305.6 .   .    .    L   .
 205           7   15   1    2   10   04R  8    366.7 .   .    .    L   .
 489           7   15   2    2   10   04R  1    366.7 .   .    .    L   .
 849           7   16   1    2   10   04R  1    366.7 .   .    .    L   .
 475           7   15   2    2   10   04R  1    611.1 .   .    .    L   .
 513   02      7   16   2    2   10   04R  1    611.1 .   .    0    L   .
 831           7   16   1    2   10   04R  2    855.6 .   .    .    L   .
 523           7   16   2    2   10   04R  1   1222.2 .   .    .    L   .
 227           7   15   1    2   10   04R  1   1833.3 .   .    0    L   .
 568   02      7   16   2    2   10   04R  1   1833.3 .   .  180    L   .
 806   02      7   16   1    2   10   04R  1   3666.7 .   .    0    L   .
 862           7   16   1    2   10   04R  0   3666.7 .   .    0    L   .
 225   02      7   15   1    2   10   04R  1   4888.9 .   .    .    L   .  30 DROP/MIN
 491           7   16   2    2   10   04R  1  12222.2 .   .  160    L   .
 873           7   16   1    2   10   04R  0  12222.2 .   .  100    L   .  SLOWDRIP TO GROUND
 453   02      7   15   2    2   10   04R  1  30555.6 .   .    .    L   .
 151           7   15   2    2   11   04R  1      0.0 .   . 1400    L   .  IN STILL PIT, NO WIND
 431           7   15   2    2   11   04R  7      0.0 .   .    .    L   .
 450           7   15   2    2   11   04R  1      0.0 .   .    .    L   .
 454           7   15   2    2   11   04R  1      0.0 .   .    .    L   .
 465           7   15   2    2   11   04R  1      0.0 .   .    .    L   .
 472           7   15   2    2   11   04R  1      0.0 .   .    .    L   .
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                                  KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981   13

ID   CCODE MONTH DAY TEAM UNIT FIT STREAM HT      OVA CO NH3 H2S STATE CN SCOM

473          7   15   2    2   11   04R   1       0.0 .   .   .    L   .
474          7   15   2    2   11   04R   1       0.0 .   .   .    L   .
487          7   15   2    2   11   04R   1       0.0 .   .   .    L   .
488          7   15   2    2   11   04R   1       0.0 .   .   .    L   .
516          7   16   2    2   11   04R   1       0.0 .   .   .    L   .
517          7   16   2    2   11   04R   1       0.0 .   .   .    L   .
518          7   16   2    2   11   04R   1       0.0 .   .   .    L   .
521          7   16   2    2   11   04R   1       0.0 .   .   .    L   .
522          7   16   2    2   11   04R   1       0.0 .   .   .    L   .
525          7   16   2    2   11   04R   1       0.0 .   .   .    L   .
526          7   16   2    2   11   04R   1       0.0 .   .   .    L   .
527          7   16   2    2   11   04R   1       0.0 .   .   .    L   .
528          7   16   2    2   11   04R   1       0.0 .   .   .    L   .
486          7   15   2    2   11   04R   1     244.4 .   .   0    L   .
524          7   16   2    2   11   04R   1     366.7 .   .   0    L   .
197          7   15   1    2   12   04R   8       0.0 .   .   .    L   .
438          7   15   2    2   12   04R   1       0.0 .   .   .    L   .
439          7   15   2    2   12   04R   1       0.0 .   .   .    L   .
440          7   15   2    2   12   04R   1       0.0 .   .   .    L   .
468          7   15   2    2   12   04R   1       0.0 .   .   0    L   .
481          7   15   2    2   12   04R   1       0.0 .   .   .    L   .
482          7   15   2    2   12   04R   1       0.0 .   .   .    L   .
483          7   15   2    2   12   04R   1       0.0 .   .   .    L   .
809          7   16   1    2   12   04R   2       0.0 .   .   .    L   .
832          7   16   1    2   15   04R   2     366.7 .   .   .    L   .  CHECK VALVE
834          7   16   1    2   15   04R   2    3666.7 .   .   .    L   .  CHECK VALVE
213          7   15   1    2   21   04R   1       0.0 .   .   .    L   .
229          7   15   1    2   21   04R   1       0.0 .   .   .    L   .
224          7   15   1    2   21   04R   1    4888.9 .   . 100    L   .
294          7   16   1    2   30   04R   1       0.0 .   .   .    L   .
801          7   16   1    2   30   04R   1      61.1 .   .   .    L   .
5            7   11   1    2   30   04R   0      97.8 .   .   .    L   .
280          7   16   1    2   30   04R   1     158.9 .   .   .    L   .
803          7   16   1    2   30   04R   1     366.7 .   .   .    L   .
6            7   11   1    2   30   04R   0    1222.2 .   .   .    L   .
296  02      7   16   1    2   30   04R   1    3666.7 .   .   .    L   .  600 DROP/MIN
287  02      7   16   1    2   33   04R   1     122.2 .   .   .    L   .  600 DROP/MIN
289  02      7   16   1    2   33   04R   1     122.2 .   .   .    L   .  6 DROP/MIN
285  02      7   16   1    2   33   04R   1     855.6 .   .   .    L   .  0.5 LITER/MIN
290  02      7   16   1    2   35   04R   1   61111.1 .   .   .    L   .  3 DP/MIN, CASE LKS GAS
282          7   16   1    2   40   04R   1       0.0 .   .   .    L   .
283          7   16   1    2   40   04R   1       0.0 .   .   .    L   .
295          7   16   1    2   40   04R   1       0.0 .   .   .    L   .
297  02      7   16   1    2   40   04R   1       0.0 .   .   .    L   .  60 DROP/MIN
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                                  KOSOVO SCREENING DATA       16:04 MONDAY, AUGUST 17, 1981   14

ID   CCODE MONTH DAY TEAM UNIT FIT STREAM HT      OVA CO NH3 H2S STATE CN SCOM

300          7   16   1    2   40   04R   1      0.00 .   .   .    L   .
867          7   16   1    2   40   04R   0     85.56 .   .   .    L   .
868          7   16   1    2   40   04R   0     85.56 .   .   .    L   .
869          7   16   1    2   40   04R   0     85.56 .   .   .    L   .
7            7   11   1    2   40   04R   0    122.22 .   .   .    L   .
281   02     7   16   1    2   40   04R   1    244.44 .   .   .    L   .  1 DROP/MIN
4            7   11   1    2   40   04R   0    244.44 .   .   .    L   .
802          7   16   1    2   40   04R   1    855.56 .   .   .    L   .
284   02     7   16   1    2   42   04R   1   3666.67 .   .   0    L   .  6 DP/MIN,CASE LKS GAS
291          7   16   1    2   43   04R   1      0.00 .   .   .    L   .
286          7   16   1    2   43   04R   1     36.67 .   .   .    L   .
288   02     7   16   1    2   43   04R   1   1222.22 .   .   .    L   .  6 DROP/MIN
606          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
607          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
608          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
609          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
610          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
611          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
612          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
613          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
614          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
615          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
617          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
618          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
619          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
620          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
621          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
622          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
623          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
624          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
625          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
626          7   17   2    2   01   05R   1      0.00 .   .   .    L   .
628          7   17   2    2   01   05R   3      0.00 .   .   .    L   .
627          7   17   2    2   01   05R   1     61.11 .   .   .    L   .
616          7   17   2    2   01   05R   1     85.56 .   .   .    L   .
547   02     7   16   2    2   03   05R   1      0.00 .   .   .    L   .
433          7   15   2    2   10   05R   1      0.00 .   .   .    L   .
449          7   15   2    2   10   05R   1      0.00 .   .   .    L   .
464          7   15   2    2   10   05R   1      0.00 .   .   .    L   .
539          7   16   2    2   10   05R   1      0.00 .   .   .    L   .
540          7   16   2    2   10   05R   1      0.00 .   .   .    L   .
541          7   16   2    2   10   05R   1      0.00 .   .   .    L   .
542          7   16   2    2   10   05R   1      0.00 .   .   .    L   .
543          7   16   2    2   10   05R   1      0.00 .   .   .    L   .
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                                        KOSOVO SCREENING DATA       16:04 MONDAY, AUGUST 17, 1981   15

ID   CCODE MONTH DAY TEAM UNIT FIT STREAM HT      OVA CO NH3 H2S STATE CN            SCOM

544          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
545          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
548          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
549          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
550          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
551          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
552          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
553          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
554          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
555          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
556          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
557          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
558          7   16   2    2   10   05R   1    0.000 .   .   .    L   .
600          7   16   2    2   10   05R   1    0.000 .   .   .    G   .
601          7   16   2    2   10   05R   3    0.000 .   .   .    G   .
602          7   16   2    2   10   05R   3    0.000 .   .   .    G   .
603          7   16   2    2   10   05R   3    0.000 .   .   .    G   .
604          7   16   2    2   10   05R   3    0.000 .   .   .    G   .
605          7   16   2    2   10   05R   3    0.000 .   .   .    L   .
434          7   15   2    2   11   05R   1    0.000 .   .   .    L   .
546          7   16   2    2   11   05R   1    0.000 .   .   .    L   .
437          7   15   2    2   12   05R   1    0.000 .   .   .    L   .
435          7   15   2    2   13   05R   1    0.000 .   .   .    L   .
436          7   15   2    2   13   05R   1    0.000 .   .   .    L   .
1            7   11   1    2   30   05R   0   85.556 .   .   .    L   .
3            7   11   1    2   40   05R   0  122.222 .   .   .    L   .
2            7   11   1    2   40   05R   0  366.667 .   .   .    L   .
637          7   17   2    2   01   06R   1    0.000 .   .   .    L   .
638          7   17   2    2   01   06R   1    0.000 .   .   .    L   .
825          7   16   1    2   10   06R   2    0.000 .   .   .    L   .
826          7   16   1    2   10   06R   1    0.000 .   .   .    L   .
827          7   16   1    2   10   06R   1    0.000 .   .   .    L   .
828          7   16   1    2   10   06R   1    0.000 .   .   .    L   .
829          7   16   1    2   10   06R   1    0.000 .   .   .    L   .
830          7   16   1    2   10   06R   1    0.000 .   .   .    L   .
292   02     7   16   1    2   30   06R   1    0.000 .   .   .    L   .  SMALL STEADY STREAM (2MM)
293   02     7   16   1    2   40   06R   1    0.000 .   .   .    L   .  600 DROP/MIN
430          7   15   2    2   03   07R   7    0.000 .   .   .    L   .
509          7   16   2    2   10   07R   1    0.000 .   .   .    L   .
510          7   16   2    2   10   07R   1    0.000 .   .   .    L   .
514          7   16   2    2   10   07R   1    0.000 .   .   .    L   .
515          7   16   2    2   10   07R   1    0.000 .   .   .    L   .
530          7   16   2    2   10   07R   1    0.000 .   .   .    L   .
425          7   15   2    2   11   07R   7    0.000 .   .   .    L   .
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                                            KOSOVO SCREENING DATA       16:04 MONDAY, AUGUST 17, 1981   16
ID   CCODE  MONTH  DAY  TEAM  UNIT  FIT  STREAM  HT      OVA  CO  NH3  H2S  STATE  CN  SCOM
426             7   15     2     2   11    07R    7     0.00   .    .    .      L    .
427             7   15     2     2   11    07R    7     0.00   .    .    .      L    .
428             7   15     2     2   11    07R    7     0.00   .    .    .      L    .
429             7   15     2     2   11    07R    7     0.00   .    .    .      L    .
507             7   16     2     2   11    07R    1     0.00   .    .    .      L    .
508             7   16     2     2   11    07R    1     0.00   .    .    .      L    .
511             7   16     2     2   11    07R    1     0.00   .    .    .      L    .
512             7   16     2     2   11    07R    1     0.00   .    .    .      L    .
506  02         7   16     2     2   11    07R    1   611.11   .    .    0      L    .
298             7   16     1     2   40    07R    1     0.00   .    .    .      L    .
299             7   16     1     2   40    07R    1     0.00   .    .    .      L    .
236             7   15     1     3   01    01P    2     0.00   .    .    .      L    .
237             7   15     1     3   01    01P    1     0.00   .    .    .      L    .
242             7   15     1     3   01    01P    9     0.00   .    .    .      L    .
246             7   15     1     3   01    01P    9     0.00   .    .    .      L    .
248             7   15     1     3   01    01P    8     0.00   .    .    .      L    .
249             7   15     1     3   01    01P    8     0.00   .    .    .      L    .
250             7   15     1     3   01    01P    8     0.00   .    .    .      L    .
264             7   15     1     3   01    01P    1     0.00   .    .    .      L    .
265             7   15     1     3   01    01P    1     0.00   .    .    .      L    .
266             7   15     1     3   01    01P    1     0.00   .    .    .      L    .
267             7   15     1     3   01    01P    1     0.00   .    .    .      L    .
268             7   15     1     3   01    01P    1     0.00   .    .    .      L    .
269             7   15     1     3   01    01P    1     0.00   .    .    .      L    .
271             7   15     1     3   01    01P    1     0.00   .    .    .      L    .
272             7   15     1     3   01    01P    2     0.00   .    .    .      L    .
273             7   15     1     3   01    01P    2     0.00   .    .    .      L    .
270             7   15     1     3   01    01P    1    61.11   .    .    .      L    .
111             7   14     1     3   03    01P    9     0.00   .    .    .      L    .
134             7   14     1     3   03    01P    1     0.00   .    .    .      L    .
174             7   14     1     3   03    01P    1     0.00   .    .    .      L    .
327             7   14     2     3   03    01P    1     0.00   .    .    .      L    .
328             7   14     2     3   03    01P    1     0.00   .    .    .      L    .
329             7   14     2     3   03    01P    1     0.00   .    .    .      L    .
330             7   14     2     3   03    01P    1     0.00   .    .    .      L    .
336             7   14     2     3   03    01P    1     0.00   .    .    .      L    .
349             7   14     2     3   03    01P    1     0.00   .    .    .      L    .
360             7   14     2     3   03    01P    1     0.00   .    .    .      L    .
361             7   14     2     3   03    01P    1     0.00   .    .    .      L    .
362             7   14     2     3   03    01P    1     0.00   .    .    .      L    .
407             7   14     2     3   03    01P    1     0.00   .    .    .      L    .
406             7   14     2     3   03    01P    3     0.00   .    .    .      L    .
405  03         7   14     2     3   03    01P    2    12.22   .    .    .      L    .
183             7   14     2     3   03    01P    1    36.67   .    .    .      L    .
                7   14     1     3   03    01P    1  1222.22   .   30    .      L    .
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                                                      KOSOVO SCREENING DATA          16:04 MONDAY, AUGUST 17, 1981   17

 ID    CCODF   MONTH   DAY   TEAM   UNIT   FIT   STREAM   HT   OVA   CO   NH3   H2S   STATE   CN   SCOM

100              7     14     1      3     10     01P      9    0     .     .     .     L      .
101              7     14     1      3     10     01P      9    0     .     .     .     L      .
102              7     14     1      3     10     01P      9    0     .     .     .     L      .
103              7     14     1      3     10     01P      9    0     .     .     .     L      .
110              7     14     1      3     10     01P      9    0     .     .     .     L      .
112              7     14     1      3     10     01P      9    0     .     .     .     L      .
113              7     14     1      3     10     01P      9    0     .     .     .     L      .
125              7     14     1      3     10     01P           0     .     .     .     L      .
126              7     14     1      3     10     01P           0     .     .     .     L      .
128              7     14     1      3     10     01P           0     .     .     .     L      .
129              7     14     1      3     10     01P           0     .     .     .     L      .
130              7     14     1      3     10     01P           0     .     .     .     L      .
164              7     14     1      3     10     01P      2    0     .     .     .     L      .
167              7     14     1      3     10     01P      1    0     .     .     .     L      .
168              7     14     1      3     10     01P      1    0     .     .     .     L      .
169              7     14     1      3     10     01P      1    0     .     .     .     L      .
172              7     14     1      3     10     01P      1    0     .     .     .     L      .
173              7     14     1      3     10     01P      1    0     .     .     .     L      .
175              7     14     1      3     10     01P      1    0     .     .     .     L      .
177              7     14     1      3     10     01P      1    0     .     .     .     L      .
178              7     14     1      3     10     01P      1    0     .     .     .     L      .
181    03        7     14     1      3     10     01P      1    0     .     .     .     L      .
301              7     14     2      3     10     01P      1    0     .     .     .     L      .
302              7     14     2      3     10     01P      1    0     .     .     .     L      .
303              7     14     2      3     10     01P      1    0     .     .     .     L      .
304              7     14     2      3     10     01P      1    0     .     .     .     L      .
305              7     14     2      3     10     01P      1    0     .     .     .     L      .
306              7     14     2      3     10     01P      1    0     .     .     .     L      .
307              7     14     2      3     10     01P      1    0     .     .     .     L      .
308              7     14     2      3     10     01P      1    0     .     .     .     L      .
309              7     14     2      3     10     01P      1    0     .     .     .     L      .
310              7     14     2      3     10     01P      1    0     .     .     .     L      .
311              7     14     2      3     10     01P      1    0     .     .     .     L      .
312              7     14     2      3     10     01P      1    0     .     .     .     L      .
313              7     14     2      3     10     01P      1    0     .     .     .     L      .
314              7     14     2      3     10     01P      1    0     .     .     .     L      .
315              7     14     2      3     10     01P      1    0     .     .     .     L      .
316              7     14     2      3     10     01P      1    0     .     .     .     L      .
317              7     14     2      3     10     01P      1    0     .     .     .     L      .
318              7     14     2      3     10     01P      1    0     .     .     .     L      .
319              7     14     2      3     10     01P      1    0     .     .     .     L      .
320              7     14     2      3     10     01P      1    0     .     .     .     L      .
321              7     14     2      3     10     01P      1    0     .     .     .     L      .
322              7     14     2      3     10     01P      1    0     .     .     .     L      .
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                                          KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981   18

ID     CCODF   MONTH   DAY   TEAM   UNIT   FIT   STREAM   HT   OVA   CO   NH3   H2S   STATE   CN   SCOM

323              7     14     2      3     10     01P     1     0     .     .     .      L      .
324              7     14     2      3     10     01P     1     0     .     .     .      L      .
325              7     14     2      3     10     01P     1     0     .     .     .      L      .
326              7     14     2      3     10     01P     1     0     .     .     .      L      .
331              7     14     2      3     10     01P     1     0     .     .     .      L      .
332              7     14     2      3     10     01P     1     0     .     .     .      L      .
333              7     14     2      3     10     01P     1     0     .     .     .      L      .
334              7     14     2      3     10     01P     1     0     .     .     .      L      .
335              7     14     2      3     10     01P     1     0     .     .     .      L      .
337              7     14     2      3     10     01P     1     0     .     .     .      L      .
338              7     14     2      3     10     01P     1     0     .     .     .      L      .
339              7     14     2      3     10     01P     1     0     .     .     .      L      .
340              7     14     2      3     10     01P     1     0     .     .     .      L      .
341              7     14     2      3     10     01P     1     0     .     .     .      L      .
342              7     14     2      3     10     01P     1     0     .     .     .      L      .
343              7     14     2      3     10     01P     1     0     .     .     .      L      .
344              7     14     2      3     10     01P     1     0     .     .     .      L      .
345              7     14     2      3     10     01P     1     0     .     .     .      L      .
346              7     14     2      3     10     01P     1     0     .     .     .      L      .
347              7     14     2      3     10     01P     1     0     .     .     .      L      .
348              7     14     2      3     10     01P     1     0     .     .     .      L      .
350              7     14     2      3     10     01P     1     0     .     .     .      L      .
351              7     14     2      3     10     01P     1     0     .     .     .      L      .
352              7     14     2      3     10     01P     1     0     .     .     .      L      .
353              7     14     2      3     10     01P     1     0     .     .     .      L      .
354              7     14     2      3     10     01P     1     0     .     .     .      L      .
355              7     14     2      3     10     01P     1     0     .     .     .      L      .
356              7     14     2      3     10     01P     1     0     .     .     .      L      .
357              7     14     2      3     10     01P     1     0     .     .     .      L      .
358              7     14     2      3     10     01P     1     0     .     .     .      L      .
359              7     14     2      3     10     01P     1     0     .     .     .      L      .
363              7     14     2      3     10     01P     1     0     .     .     .      L      .
364              7     14     2      3     10     01P     1     0     .     .     .      L      .
365              7     14     2      3     10     01P     1     0     .     .     .      L      .
366              7     14     2      3     10     01P     1     0     .     .     .      L      .
367              7     14     2      3     10     01P     1     0     .     .     .      L      .
368              7     14     2      3     10     01P     1     0     .     .     .      L      .
369              7     14     2      3     10     01P     1     0     .     .     .      L      .
370              7     14     2      3     10     01P     1     0     .     .     .      L      .
371              7     14     2      3     10     01P     1     0     .     .     .      L      .
372              7     14     2      3     10     01P     1     0     .     .     .      L      .
373              7     14     2      3     10     01P     1     0     .     .     .      L      .
374              7     14     2      3     10     01P     1     0     .     .     .      L      .
375              7     14     2      3     10     01P     2     0     .     .     .      L      .
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                                        KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981   19

ID    CCODE  MONTH  DAY  TEAM  UNIT  FIT  STREAM  HT     OVA  CO   NH3  H2S  STATE  CN  SCOM

376            7    14    2     3    10    01P    1        0   .     .    .     L    .
377            7    14    2     3    10    01P    1        0   .     .    .     L    .
378            7    14    2     3    10    01P    1        0   .     .    .     L    .
379            7    14    2     3    10    01P    1        0   .     .    .     L    .
380            7    14    2     3    10    01P    1        0   .     .    .     L    .
408            7    14    2     3    10    01P    1        0   .     .    .     L    .
409            7    14    2     3    10    01P    1        0   .     .    .     L    .
410            7    14    2     3    10    01P    1        0   .     .    .     L    .
91             7    14    1     3    10    01P    9        0   .     .    .     L    .
92             7    14    1     3    10    01P    9        0   .     .    .     L    .
127            7    14    1     3    10    01P        122223   .  5000    .     L    .
170    03      7    14    1     3    30    01P    1        0   .     .    .     L    .
165            7    14    1     3    30    01P    1       31   .     .    .     L    .
180            7    14    1     3    30    01P    1      244   .     .    .     L    .
176    03      7    14    1     3    30    01P    1     1222   .     .    .     L    .
166            7    14    1     3    40    01P    1        0   .     .    .     L    .
171            7    14    1     3    40    01P    1        0   .     .    .     L    .
179            7    14    1     3    40    01P    1        0   .     .    .     L    .
182            7    14    1     3    40    01P    1        0   .     .    .     L    .
276            7    15    1     3    01    02P    1        0   .     .    .     G    .
277            7    15    1     3    01    02P    3        0   .     .    .     G    .
278            7    15    1     3    01    02P    3        0   .     .    .     G    .
279            7    15    1     3    01    02P    3      122   .     .    .     G    .
403            7    14    2     3    03    02P    1        0   .     .    .     L    .
122            7    14    1     3    10    02P    3        0   .     .    .     L    .
123            7    14    1     3    10    02P             0   .     .    .     L    .
124            7    14    1     3    10    02P             0   .     .    .     L    .
148            7    14    1     3    10    02P    1        0   .     .    .     G    .
149            7    14    1     3    10    02P    1        0   .     .    .     L    .
150            7    14    1     3    10    02P    1        0   .     .    .     L    .
151            7    14    1     3    10    02P    1        0   .     .    .     L    .
152            7    14    1     3    10    02P    2        0   .     .    .     G    .
154            7    14    1     3    10    02P    1        0   .     .    .     L    .
155            7    14    1     3    10    02P    1        0   .     .    .     L    .
156            7    14    1     3    10    02P    1        0   .     .    .     L    .
157            7    14    1     3    10    02P    2        0   .     .    .     L    .
161            7    14    1     3    10    02P    4        0   .     .    .     G    .
186            7    14    1     3    10    02P    1        0   .     .    .     L    .
385            7    14    2     3    10    02P    1        0   .     .    .     L    .
386            7    14    2     3    10    02P    1        0   .     .    .     L    .
387    02      7    14    2     3    10    02P    1        0   .     .    .     L    .
388            7    14    2     3    10    02P    1        0   .     .    .     L    .
389            7    14    2     3    10    02P    1        0   .     .    .     L    .
390            7    14    2     3    10    02P    1        0   .     .    .     L    .
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                                          KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981   20

ID    CCODE  MONTH   DAY   TEAM   UNIT   FIT   STREAM   HT      OVA   CO   NH3   H2S   STATE   CN   SCOM

391            7     14     2      3     10     02P      1      0.00   .     .     .      L      .
392            7     14     2      3     10     02P      1      0.00   .     .     .      L      .
401            7     14     2      3     36     02P      1    122.22   .     .     .      L      .
402            7     14     2      3     36     02P      1    244.44   .     .     .      L      .
400    03      7     14     2      3     36     02P      1   1222.22   .     .     .      L      .
399            7     14     2      3     46     02P      1      0.00   .     .     .      L      .
238            7     15     1      3     01     03P      9      0.00   .     .     .      L      .
239            7     15     1      3     01     03P      9      0.00   .     .     .      L      .
240            7     15     1      3     01     03P      9      0.00   .     .     .      L      .
241            7     15     1      3     01     03P      9      0.00   .     .     .      L      .
243            7     15     1      3     01     03P      9      0.00   .     .     .      L      .
244            7     15     1      3     01     03P      9      0.00   .     .     .      L      .
245            7     15     1      3     01     03P      9      0.00   .     .     .      L      .
251            7     15     1      3     01     03P      8      0.00   .     .     .      L      .
252            7     15     1      3     01     03P      1      0.00   .     .     .      L      .
253            7     15     1      3     01     03P      1      0.00   .     .     .      L      .
255            7     15     1      3     01     03P      1      0.00   .     .     .      G      .
256            7     15     1      3     01     03P      1      0.00   .     .     .      G      .
257            7     15     1      3     01     03P      1      0.00   .     .     .      G      .
258            7     15     1      3     01     03P      1      0.00   .     .     .      G      .
259            7     15     1      3     01     03P      1      0.00   .     .     .      G      .
260            7     15     1      3     01     03P      1      0.00   .     .     .      G      .
261            7     15     1      3     01     03P      1      0.00   .     .     .      G      .
262            7     15     1      3     01     03P      1      0.00   .     .     .      G      .
263            7     15     1      3     01     03P      1      0.00   .     .     .      G      .
121            7     14     1      3     03     03P      3      0.00   .     .     .      L      .
133            7     14     1      3     03     03P      3      0.00   .     .     .      L      .
139            7     14     1      3     03     03P      2      0.00   .     .     .      L      .
163            7     14     1      3     03     03P      4      0.00   .     .     .      L      .
404            7     14     2      3     03     03P      1    122.22   .     .     .      L      .
105    02      7     14     1      3     03     03P      9    611.11   .     .     .      L      .
162            7     14     1      3     10     03P      4      0.00   .     .     .      G      .
104            7     14     1      3     10     03P      9      0.00   .     .     .      L      .
106            7     14     1      3     10     03P      9      0.00   .     .     .      L      .
107            7     14     1      3     10     03P      9      0.00   .     .     .      L      .
109            7     14     1      3     10     03P      9      0.00   .     .     .      L      .
114            7     14     1      3     10     03P      9      0.00   .     .     .      L      .
115            7     14     1      3     10     03P      9      0.00   .     .     .      L      .
116            7     14     1      3     10     03P      9      0.00   .     .     .      L      .
117            7     14     1      3     10     03P      9      0.00   .     .     .      L      .
118            7     14     1      3     10     03P      9      0.00   .     .     .      L      .
119            7     14     1      3     10     03P      9      0.00   .     .     .      L      .
120            7     14     1      3     10     03P      9      0.00   .     .     .      L      .
131            7     14     1      3     10     03P      3      0.00   .     .     .      L      .
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                                        KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981   21
ID  CCODE MONTH DAY TEAM UNIT FIT STREAM HT      OVA CO NH3 H2S STATE CN          SCOM

132          7  14    1    3  10   03P   3      0.00 .    .   .    L   .
135          7  14    1    3  10   03P   1      0.00 .    .   .    L   .
136          7  14    1    3  10   03P   1      0.00 .    .   .    L   .
140          7  14    1    3  10   03P   2      0.00 .    .   .    L   .
141          7  14    1    3  10   03P   2      0.00 .    .   .    L   .
142          7  14    1    3  10   03P   1      0.00 .    .   .    L   .
143          7  14    1    3  10   03P   3      0.00 .    .   .    L   .
144          7  14    1    3  10   03P   3      0.00 .    .   .    G   .
146          7  14    1    3  10   03P   1      0.00 .    .   .    L   .
147          7  14    1    3  10   03P   1      0.00 .    .   .    L   .
158          7  14    1    3  10   03P   1      0.00 .    .   .    L   .
159          7  14    1    3  10   03P   2      0.00 .    .   .    L   .
160          7  14    1    3  10   03P   1      0.00 .    .   .    L   .
393          7  14    2    3  10   03P   1      0.00 .    .   .    L   .
394          7  14    2    3  10   03P   1      0.00 .    .   .    L   .
395          7  14    2    3  10   03P   1      0.00 .    .   .    L   .
398          7  14    2    3  10   03P   1      0.00 .    .   .    L   .
89           7  14    1    3  10   03P   9      0.00 .    .   .    G   .
90           7  14    1    3  10   03P   9      0.00 .    .   .    L   .
94           7  14    1    3  10   03P   9      0.00 .    .   .    L   .
95           7  14    1    3  10   03P   9      0.00 .    .   .    L   .
96           7  14    1    3  10   03P   9      0.00 .    .   .    L   .
97           7  14    1    3  10   03P   9      0.00 .    .   .    L   .
98           7  14    1    3  10   03P   9      0.00 .    .   .    L   .
99           7  14    1    3  10   03P   9      0.00 .    .   .    L   .
397          7  14    2    3  10   03P   1     30.56 .    .   .    L   .
396          7  14    2    3  10   03P   1    244.44 .    .   .    L   .
93           7  14    1    3  10   03P   9   1222.22 .   30   .    L   .
108          7  14    1    3  10   03P   9   8555.55 .    .   .    L   0
247          7  15    1    3  01   04P   9      0.00 .    .   .    L   .
381          7  14    2    3  10   04P   0      0.00 .    .   .    L   .
382          7  14    2    3  10   04P   1      0.00 .    .   .    L   .
384          7  14    2    3  10   04P   1      0.00 .    .   .    L   .
383          7  14    2    3  10   04P   1   4888.89 .    4   .    L   .   PUMP OP. 0.5 HR/DAY
411          7  14    2    3  40   04P   1      0.00 .    .   .    L   .
254          7  15    1    3  01   05P   4      0.00 .    .   .    L   .
274          7  15    1    3  01   05P   3      0.00 .    .   .    G   .
275          7  15    1    3  01   05P   1      0.00 .    .   .    G   .
185          7  14    1    3  03   05P   2     61.11 .    .   .    L   .
137          7  14    1    3  10   05P   1      0.00 .    .   .    L   .
138          7  14    1    3  10   05P   2      0.00 .    .   .    L   .
184          7  14    1    3  10   05P   3      0.00 .    .   .    L   .
234          7  15    1    3  01   06P   1      0.00 .    .   .    L   .
238          7  15    1    3  01   06P   1      0.00 .    .   .    L   .
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                                              KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981   22

ID     CCODE   MONTH   DAY   TEAM   UNIT   FIT   STREAM   HT   OVA   CO   NH3   H2S   STATE   CN   SCOM

231              7     15     1      3     40     06P     1     0    .     .     .      L     .
232              7     15     1      3     40     06P     1     0    .     .     .      L     .
233              7     15     1      3     40     06P     1     0    .     .     .      L     .
1091             7     21     1      4     01     01G     9     0    .     .     .      G     .
1092             7     21     1      4     01     01G     9     0    .     .     .      G     .
1094             7     21     1      4     01     01G     2     0    .     .     .      G     .
1100             7     21     1      4     01     01G     2     0    .     .     .      G     .
1103             7     21     1      4     01     01G     2     0    .     .     .      G     .
1106             7     21     1      4     01     01G     2     0    .     .     .      G     .
1110             7     21     1      4     01     01G     1     0    .     .     .      G     .
915              7     17     1      4     01     01G     9     0    .     .     .      G     .
916              7     17     1      4     01     01G     9     0    .     .     .      G     .
917              7     17     1      4     01     01G     9     0    .     .     .      G     .
918              7     17     1      4     01     01G     2     0    .     .     .      G     .
919              7     17     1      4     01     01G     2     0    .     .     .      G     .
920              7     17     1      4     01     01G     2     0    .     .     .      G     .
921              7     17     1      4     01     01G     2     0    .     .     .      G     .
922              7     17     1      4     01     01G     2     0    .     .     .      G     .
923              7     17     1      4     01     01G     2     0    .     .     .      G     .
924              7     17     1      4     01     01G     2     0    .     .     .      G     .
1104             7     21     1      4     03     01G     2     0    .     .     .      G     .
1108             7     21     1      4     03     01G     1     0    .     .     .      G     .
892              7     17     1      4     03     01G     1     0    .     .     .      G     .
898              7     17     1      4     03     01G     1     0    .     .     .      G     .
1089             7     21     1      4     10     01G     9     0    .     .     .      G     .
1093             7     21     1      4     10     01G     3     0    .     .     .      G     .
800              7     21     1      4     10     01G     9     0    .     .     .      G     .
879              7     17     1      4     10     01G     9     0    .     .     .      G     .
880              7     17     1      4     10     01G     9     0    .     .     .      G     .
881              7     17     1      4     10     01G     9     0    .     .     .      G     .
882              7     17     1      4     10     01G     9     0    .     .     .      G     .
883              7     17     1      4     10     01G     9     0    .     .     .      G     .
884              7     17     1      4     10     01G     9     0    .     .     .      G     .
885              7     17     1      4     10     01G     9     0    .     .     .      G     .
886              7     17     1      4     10     01G     9     0    .     .     .      G     .
887              7     17     1      4     10     01G     9     0    .     .     .      G     .
888              7     17     1      4     10     01G     3     0    .     .     .      G     .
889              7     17     1      4     10     01G     3     0    .     .     .      G     .
891              7     17     1      4     10     01G     2     0    .     .     .      G     .
893              7     17     1      4     10     01G     2     0    .     .     .      G     .
894              7     17     1      4     10     01G     1     0    .     .     .      G     .
895              7     17     1      4     10     01G     1     0    .     .     .      G     .
896              7     17     1      4     10     01G     2     0    .     .     .      G     .
897              7     17     1      4     10     01G     2     0    .     .     .      G     .
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                                               KOSOVO SCREENING DATA       16:04 MONDAY, AUGUST 17, 1981   23

  ID     CCODE   MONTH   DAY   TEAM   UNIT   FIT   STREAM   HT   OVA   CO   NH3   H2S   STATE   CN   SCOM

  899               7     17     1      4     10    01G      2     0    .     .     .      G     .
  901               7     17     1      4     10    01G      9     0    .     .     .      G     .
  902               7     17     1      4     10    01G      9     0    .     .     .      G     .
  904               7     17     1      4     10    01G      9     0    .     .     .      G     .
  905               7     17     1      4     10    01G      9     0    .     .     .      G     .
  906               7     17     1      4     10    01G      9     0    .     .     .      G     .
  907               7     17     1      4     10    01G      9     0    .     .     .      G     .
  908               7     17     1      4     10    01G      9     0    .     .     .      G     .
  909               7     17     1      4     10    01G      9     0    .     .     .      G     .
  910               7     17     1      4     10    01G      9     0    .     .     .      G     .
  911               7     17     1      4     10    01G      9     0    .     .     .      G     .
  912               7     17     1      4     10    01G      9     0    .     .     .      G     .
  913               7     17     1      4     10    01G      9     0    .     .     .      G     .
  914               7     17     1      4     10    01G      9     0    .     .     .      G     .
 1088               7     21     1      4     11    01G      9     0    .     .     .      G     .
 1090               7     21     1      4     11    01G      9     0    .     .     .      G     .
 1095               7     21     1      4     11    01G      2     0    .     .     .      G     .
 1096               7     21     1      4     11    01G      2     0    .     .     .      G     .
 1097               7     21     1      4     11    01G      2     0    .     .     .      G     .
 1098               7     21     1      4     11    01G      2     0    .     .     .      G     .
 1099               7     21     1      4     11    01G      2     0    .     .     .      G     .
 1101               7     21     1      4     11    01G      2     0    .     .     .      G     .
 1102               7     21     1      4     11    01G      2     0    .     .     .      G     .
 1105               7     21     1      4     11    01G      2     0    .     .     .      G     .
 1107               7     21     1      4     11    01G      2     0    .     .     .      G     .
 1109               7     21     1      4     11    01G      1     0    .     .     .      G     .
  900               7     17     1      4     12    01G      9     0    .     .     .      G     .
  890               7     17     1      4     21    01G      3     0    .     .     .      G     .
  903               7     17     1      4     21    01G      9     0    .     .     .      G     .
  660               7     17     2      4     01    02G      1     0    .     .     .      L     .
  661               7     17     2      4     01    02G      1     0    .     .     .      L     .
  662               7     17     2      4     01    02G      1     0    .     .     .      L     .
  663               7     17     2      4     01    02G      1     0    .     .     .      L     .
  664               7     17     2      4     01    02G      1     0    .     .     .      L     .
  665               7     17     2      4     01    02G      1     0    .     .     .      L     .
  666               7     17     2      4     01    02G      1     0    .     .     .      L     .
  667               7     17     2      4     01    02G      1     0    .     .     .      L     .
  668               7     17     2      4     01    02G      1     0    .     .     .      L     .
  669               7     17     2      4     01    02G      1     0    .     .     .      L     .
  670               7     17     2      4     01    02G      1     0    .     .     .      L     .
  671               7     17     2      4     01    02G      1     0    .     .     .      L     .
  672               7     17     2      4     01    02G      1     0    .     .     .      L     .
  673               7     17     2      4     01    02G      1     0    .     .     .      L     .
  674               7     17     2      4     01    02G      1     0    .     .     .      L     .
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                                          KOSOVO SCREENING DATA          16:04 MONDAY, AUGUST 17, 1981    24
ID     CCODE  MONTH  DAY  TEAM  UNIT  FIT  STREAM  HT      OVA     CO    NH3    H2S  STATE  CN  SCOM

675              7    17    2     4    01   02G     1        0      .     .      .     L    .
676              7    17    2     4    01   02G     1        0      .     .      .     L    .
677              7    17    2     4    01   02G     1        0      .     .      .     L    .
678              7    17    2     4    01   02G     1        0      .     .      .     L    .
679              7    17    2     4    01   02G     1        0      .     .      .     L    .
1111             7    21    1     4    10   02G     1        0      .     .      .     L    .
1112             7    21    1     4    10   02G     1        0      .     .      .     L    .
1113             7    21    1     4    10   02G     1        0      .     .      .     L    .
1114             7    21    1     4    10   02G     1        0      .     .      .     L    .
1119             7    21    1     4    10   02G     1        0      .     .      .     L    .
1123             7    21    1     4    10   02G     1        0      .     .      .     L    .
1125             7    21    1     4    10   02G     1        0      .     .      .     L    .
1126             7    21    1     4    10   02G     1        0      .     .      .     L    .
1127             7    21    1     4    10   02G     1        0      .     .      .     L    .
1128             7    21    1     4    10   02G     1        0      .     .      .     L    .
1129             7    21    1     4    10   02G     1        0      .     .      .     L    .
1130             7    21    1     4    10   02G     1        0      .     .      .     L    .
1131             7    21    1     4    10   02G     1        0      .     .      .     L    .
1133             7    21    1     4    10   02G     1        0      .     .      .     L    .
649              7    17    2     4    10   02G     1        0      .     .      .     L    .
650              7    17    2     4    10   02G     1        0      .     .      .     L    .
1124             7    21    1     4    10   02G     1       37      .     .      .     L    .
1115             7    21    1     4    11   02G     1        0      .     .      .     L    .
1116             7    21    1     4    11   02G     1        0      .     .      .     L    .
1117             7    21    1     4    11   02G     1        0      .     .      .     L    .
1118             7    21    1     4    11   02G     1        0      .     .      .     L    .
1120             7    21    1     4    11   02G     1        0      .     .      .     L    .
1121             7    21    1     4    11   02G     1        0      .     .      .     L    .
1122             7    21    1     4    11   02G     1        0      .     .      .     L    .
645              7    17    2     4    11   02G     1        0      .     .      .     L    .
646              7    17    2     4    11   02G     1        0      .     .      .     L    .
647              7    17    2     4    11   02G     1        0      .     .      .     L    .
648              7    17    2     4    11   02G     1        0      .     .      .     L    .
651              7    17    2     4    11   02G     1        0      .     .      .     L    .
652              7    17    2     4    11   02G     1        0      .     .      .     L    .
653              7    17    2     4    11   02G     1        0      .     .      .     L    .
654              7    17    2     4    11   02G     1        0      .     .      .     L    .
655              7    17    2     4    11   02G     1        0      .     .      .     L    .
656              7    17    2     4    11   02G     1        0      .     .      .     L    .
657              7    17    2     4    11   02G     1        0      .     .      .     L    .
658              7    17    2     4    11   02G     1        0      .     .      .     L    .
659              7    17    2     4    11   02G     1        0      .     .      .     L    .
1132             7    21    1     4    25   02G     1   122223  70001    .   7001     L    .
1073             7    18    1     5    01   01T     0        0      .     .      .     L    .
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                                       KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981   25

ID     CCODE   MONTH   DAY   TEAM   UNIT   FIT   STREAM   HT       OVA   CO   NH3   H2S   STATE   CN   SCOM

1074             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1075             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1076             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1077             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1078             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1079             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1080             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1081             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1082             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1083             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1084             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1085             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1086             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
1087             7     18     1      5     01     01T     0      0.000    .     .     .      L     .
746              7     21     1      5     01     01T     9      0.000    .     .     .      L     .
748              7     21     1      5     01     01T     9      0.000    .     .     .      L     .
756              7     21     1      5     01     01T     9      0.000    .     .     .      L     .
757              7     21     1      5     01     01T     9      0.000    .     .     .      L     .
759              7     21     1      5     01     01T     9      0.000    .     .     .      L     .
760              7     21     1      5     01     01T     9      0.000    .     .     .      L     .
761              7     21     1      5     01     01T     9      0.000    .     .     .      L     .
762              7     21     1      5     01     01T     8      0.000    .     .     .      L     .
763              7     21     1      5     01     01T     8      0.000    .     .     .      L     .
764              7     21     1      5     01     01T     8      0.000    .     .     .      L     .
765              7     21     1      5     01     01T     8      0.000    .     .     .      L     .
766              7     21     1      5     01     01T     8      0.000    .     .     .      L     .
767              7     21     1      5     01     01T     8      0.000    .     .     .      L     .
768              7     21     1      5     01     01T     8      0.000    .     .     .      L     .
769              7     21     1      5     01     01T     8      0.000    .     .     .      L     .
770              7     21     1      5     01     01T     8      0.000    .     .     .      L     .
771              7     21     1      5     01     01T     8      0.000    .     .     .      L     .
772              7     21     1      5     01     01T     8      0.000    .     .     .      L     .
773              7     21     1      5     01     01T     8      0.000    .     .     .      L     .
784              7     21     1      5     01     01T     7      0.000    .     .     .      L     .
787              7     21     1      5     01     01T     7      0.000    .     .     .      L     .
790              7     21     1      5     01     01T     5      0.000    .     .     .      L     .
798              7     21     1      5     01     01T     5      0.000    .     .     .      L     .
1045             7     18     1      5     03     01T     0      0.000    .     .     .      L     .
972              7     18     1      5     03     01T     1      0.000    .     .     .      L     .
975              7     18     1      5     03     01T     2      0.000    .     .     .      L     .
984              7     18     1      5     03     01T     2    122.222    .     .     .      L     .
1001             7     18     1      5     10     01T     4      0.000    .     .     .      L     .
1002             7     18     1      5     10     01T     4      0.000    .     .     .      L     .
1033             7     18     1      5     10     01T     0      0.000    .     .     .      L     .
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                                    KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981   26

  ID    CCODE   MONTH   DAY   TEAM   UNIT   FIT   STREAM   HT   OVA   CO   NH3   H2S   STATE   CN   SCOM

 1034             7     18     1      5     10     01T     0     0    .     .     .      L     .
 1035             7     18     1      5     10     01T     0     0    .     .     .      L     .
 1036             7     18     1      5     10     01T     0     0    .     .     .      L     .
 1038             7     18     1      5     10     01T     0     0    .     .     .      L     .
 1039             7     18     1      5     10     01T     0     0    .     .     .      L     .
 1040             7     18     1      5     10     01T     0     0    .     .     .      L     .
 1041             7     18     1      5     10     01T     0     0    .     .     .      L     .
 1042             7     18     1      5     10     01T     0     0    .     .     .      L     .
 1043             7     18     1      5     10     01T     0     0    .     .     .      L     .
 1044             7     18     1      5     10     01T     0     0    .     .     .      L     .
 1047             7     18     1      5     10     01T     0     0    .     .     .      L     .
 1048             7     18     1      5     10     01T     0     0    .     .     .      L     .
  681             7     18     2      5     10     01T     9     0    .     .     .      L     .
  682             7     18     2      5     10     01T     9     0    .     .     .      L     .
  683             7     18     2      5     10     01T     9     0    .     .     .      L     .
  684             7     18     2      5     10     01T     9     0    .     .     .      L     .
  685             7     18     2      5     10     01T     9     0    .     .     .      L     .
  686             7     18     2      5     10     01T     9     0    .     .     .      L     .
  687             7     18     2      5     10     01T     9     0    .     .     .      L     .
  688             7     18     2      5     10     01T     9     0    .     .     .      L     .
  695             7     18     2      5     10     01T     9     0    .     .     .      L     .
  696             7     18     2      5     10     01T     9     0    .     .     .      L     .
  697             7     18     2      5     10     01T     9     0    .     .     .      L     .
  698             7     18     2      5     10     01T     9     0    .     .     .      L     .
  699             7     18     2      5     10     01T     9     0    .     .     .      L     .
  700             7     18     2      5     10     01T     9     0    .     .     .      L     .
  701             7     18     2      5     10     01T     8     0    .     .     .      L     .
  702             7     18     2      5     10     01T     8     0    .     .     .      L     .
  703             7     18     2      5     10     01T     8     0    .     .     .      L     .
  704             7     18     2      5     10     01T     8     0    .     .     .      L     .
  705             7     18     2      5     10     01T     8     0    .     .     .      L     .
  706             7     18     2      5     10     01T     8     0    .     .     .      L     .
  707             7     18     2      5     10     01T     8     0    .     .     .      L     .
  708             7     18     2      5     10     01T     8     0    .     .     .      L     .
  709             7     18     2      5     10     01T     8     0    .     .     .      L     .
  710             7     18     2      5     10     01T     8     0    .     .     .      L     .
  712             7     18     2      5     10     01T     7     0    .     .     .      L     .
  713             7     18     2      5     10     01T     7     0    .     .     .      L     .
  714             7     18     2      5     10     01T     7     0    .     .     .      L     .
  715             7     18     2      5     10     01T     7     0    .     .     .      L     .
  743             7     21     1      5     10     01T     9     0    .     .     .      L     .
  744             7     21     1      5     10     01T     9     0    .     .     .      L     .
  745             7     21     1      5     10     01T     9     0    .     .     .      L     .
  747             7     21     1      5     10     01T     9     0    .     .     .      L     .
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RADIAN
CORPORATION

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                                        KOSOVO SCREENING DATA       16:04 MONDAY, AUGUST 17, 1981   27

ID    CCODF MONTH DAY TEAM UNIT FIT STREAM HT     OVA CO NH3 H2S STATE CN SCOM

749           7   21    1    5   10   01T   9    0,000 .   .   .    L   .
979           7   18    1    5   10   01T   1    0,000 .   .   .    L   .
980           7   18    1    5   10   01T   1    0,000 .   .   .    L   .
981           7   18    1    5   10   01T   1    0,000 .   .   .    L   .
988           7   18    1    5   10   01T   1    0,000 .   .   .    L   .
989           7   18    1    5   10   01T   1    0,000 .   .   .    L   .
990           7   18    1    5   10   01T   1    0,000 .   .   .    L   .
996           7   18    1    5   10   01T   4    0,000 .   .   .    L   .
997           7   18    1    5   10   01T   4    0,000 .   .   .    L   .
999           7   18    1    5   10   01T   4    0,000 .   .   .    L   .
711           7   18    2    5   10   01T   7   36,667 .   .   .    L   .
983           7   18    1    5   10   01T   2   61,111 .   .   .    L   .
1037          7   18    1    5   10   01T   0  183,333 .   .   .    L   .
1046          7   18    1    5   11    1T   0    0,000 .   .   .    L   .
971           7   18    1    5   12   01T   1    0,000 .   .   .    L   .
973           7   18    1    5   12   01T   1    0,000 .   .   .    L   .
974           7   18    1    5   12   01T   2    0,000 .   .   .    L   .
1024  03      7   18    1    5   30   01T   0  183,333 .   .   .    L   .  2 LITER/MIN (EST)
1021  03      7   29    1    5   33   01T   0  366,667 .   .   .    L   .  0.2 L/M SEAL, 0.9 L/M CWATR
1018  03      7   29    1    5   33   01T   0  733,333 .   .   .    L   .  6.6 L/M FR 2 SEALS INC. CW
1018  03      7   18    1    5   33   01T   0  855,555 .   .   .    L   .  1 LITER/MIN (EST)
1021  03      7   18    1    5   33   01T   0  855,555 .   .   .    L   .  1 LITER/MIN (EST)
1023          7   18    1    5   40   01T   0    0,000 .   .   .    L   .
1023          7   29    1    5   40   01T   0    0,000 .   .   .    L   .
1024          7   29    1    5   40   01T   0    0,000 .   .   .    L   .
1019          7   18    1    5   43   01T   0    0,000 .   .   .    L   .
1019          7   29    1    5   43   01T   0    0,000 .   .   .    L   .
1020          7   18    1    5   43   01T   0    0,000 .   .   .    L   .
1020          7   29    1    5   43   01T   0    0,000 .   .   .    L   .
1022          7   18    1    5   43   01T   0    0,000 .   .   .    L   .
1022          7   29    1    5   43   01T   0    0,000 .   .   .    L   .
799           7   21    1    5   01   02T   5    0,000 .   .   .    G   .
750           7   21    1    5   01   02T   9    0,000 .   .   .    G   .
751           7   21    1    5   01   02T   9    0,000 .   .   .    G   .
752           7   21    1    5   01   02T   9    0,000 .   .   .    G   .
753           7   21    1    5   01   02T   9    0,000 .   .   .    G   .
754           7   21    1    5   01   02T   9    0,000 .   .   .    G   .
755           7   21    1    5   01   02T   9    0,000 .   .   .    G   .
774           7   21    1    5   01   02T   8    0,000 .   .   .    G   .
775           7   21    1    5   01   02T   8    0,000 .   .   .    G   .
776           7   21    1    5   01   02T   8    0,000 .   .   .    G   .
777           7   21    1    5   01   02T   8    0,000 .   .   .    G   .
778           7   21    1    5   01   02T   8    0,000 .   .   .    G   .
779           7   21    1    5   01   02T   8    0,000 .   .   .    G   .
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                                        KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981   28

 ID    CCODE  MONTH  DAY  TEAM  UNIT  FIT  STREAM  HT  OVA  CO  NH3  H2S  STATE  CN      SCOM

 780            7    21    1     5    01    02T     8   0    .    .    .     G    .
 781            7    21    1     5    01    02T     8   0    .    .    .     G    .
 782            7    21    1     5    01    02T     8   0    .    .    .     G    .
 783            7    21    1     5    01    02T     7   0    .    .    .     G    .
 785            7    21    1     5    01    02T     7   0    .    .    .     G    .
 786            7    21    1     5    01    02T     7   0    .    .    .     G    .
 788            7    21    1     5    01    02T     5   0    .    .    .     G    .
 789            7    21    1     5    01    02T     5   0    .    .    .     G    .
 791            7    21    1     5    01    02T     5   0    .    .    .     G    .
 792            7    21    1     5    01    02T     5   0    .    .    .     G    .
 793            7    21    1     5    01    02T     5   0    .    .    .     G    .
 794            7    21    1     5    01    02T     5   0    .    .    .     G    .
 795            7    21    1     5    01    02T     5   0    .    .    .     G    .
 797            7    21    1     5    01    02T     5   0    .    .    .     G    .
1017            7    18    1     5    03    02T     4   0    .    .    .     G    .
1009            7    18    1     5    10    02T     3   0    .    .    .     G    .
1010            7    18    1     5    10    02T     3   0    .    .    .     G    .
1011            7    18    1     5    10    02T     4   0    .    .    .     G    .
1012            7    18    1     5    10    02T     4   0    .    .    .     G    .
1013            7    18    1     5    10    02T     4   0    .    .    .     G    .
1014            7    18    1     5    10    02T     4   0    .    .    .     G    .
1015            7    18    1     5    10    02T     4   0    .    .    .     G    .
1016            7    18    1     5    10    02T     4   0    .    .    .     G    .
 722            7    18    2     5    10    02T     5   0    .    .    .     G    .
 723            7    18    2     5    10    02T     5   0    .    .    .     G    .
 130            7    18    2     5    11    02T     3   0    .    .    .     G    .
 721            7    18    2     5    11    02T     5   0    .    .    .     G    .
 724            7    18    2     5    11    02T     5   0    .    .    .     G    .
 725            7    18    2     5    11    02T     5   0    .    .    .     G    .
 726            7    18    2     5    11    02T     3   0    .    .    .     G    .
 727            7    18    2     5    11    02T     3   0    .    .    .     G    .
 728            7    18    2     5    11    02T     3   0    .    .    .     G    .
 729            7    18    2     5    11    02T     3   0    .    .    .     G    .
 731            7    18    2     5    11    02T     9   0    .    .    .     G    .
 732            7    18    2     5    11    02T     9   0    .    .    .     G    .
 733            7    18    2     5    11    02T     9   0    .    .    .     G    .
 734            7    18    2     5    11    02T     9   0    .    .    .     G    .
 735            7    18    2     5    11    02T     9   0    .    .    .     G    .
 736            7    18    2     5    11    02T     9   0    .    .    .     G    .
 737            7    18    2     5    11    02T     9   0    .    .    .     G    .
 738            7    18    2     5    11    02T     9   0    .    .    .     G    .
 739    02      7    18    2     5    11    02T     9   0    .    .    .     G    .   26 DROP/MIN
 740            7    18    2     5    11    02T     9   0    .    .    .     G    .
 741    02      7    18    2     5    11    02T     9   0    .    .    .     G    .   15 DROP/MIN
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ID    CCODE MONTH DAY TEAM UNIT FIT STREAM HT     OVA  CO NH3 H2S STATE CN SCOM

742           7   18    2    5   11   02T   9     0.00 .   .   .    G    .
1068          7   18    1    5   01   03T   0     0.00 .   .   .    L    .
1069          7   18    1    5   01   03T   0     0.00 .   .   .    L    .
1070          7   18    1    5   01   03T   0     0.00 .   .   .    L    .
796           7   21    1    5   01   03T   5     0.00 .   .   .    L    .
964           7   18    1    5   03   03T   1     0.00 .   .   .    L    .
994           7   18    1    5   03   03T   1     0.00 .   .   .    L    .
986           7   18    1    5   03   03T   2  1222.22 .   .   .    L    .
1000          7   18    1    5   10   03T   4     0.00 .   .   .    L    .
1007          7   18    1    5   10   03T   3     0.00 .   .   .    G    .
1054          7   18    1    5   10   03T   0     0.00 .   .   .    L    .
1055          7   18    1    5   10   03T   0     0.00 .   .   .    L    .
1056          7   18    1    5   10   03T   0     0.00 .   .   .    L    .
1057          7   18    1    5   10   03T   0     0.00 .   .   .    L    .
1058          7   18    1    5   10   03T   0     0.00 .   .   .    L    .
962           7   18    1    5   10   03T   1     0.00 .   .   .    L    .
966           7   18    1    5   10   03T   1     0.00 .   .   .    L    .
967           7   18    1    5   10   03T   1     0.00 .   .   .    L    .
968           7   18    1    5   10   03T   1     0.00 .   .   .    L    .
969           7   18    1    5   10   03T   1     0.00 .   .   .    L    .
970           7   18    1    5   10   03T   2     0.00 .   .   .    L    .
985           7   18    1    5   10   03T   2     0.00 .   .   .    L    .
991           7   18    1    5   10   03T   1     0.00 .   .   .    L    .
992           7   18    1    5   10   03T   1     0.00 .   .   .    L    .
998           7   18    1    5   10   03T   4     0.00 .   .   .    L    .
987    03     7   18    1    5   10   03T   1  1222.22 .   .   .    L    .  60 DROP/MIN, CLEAR AMBER
963           7   18    1    5   12   03T   1     0.00 .   .   .    L    .
965           7   18    1    5   12   03T   2     0.00 .   .   .    L    .
995           7   18    1    5   12   03T   2     0.00 .   .   .    L    .
993           7   18    1    5   12   03T   1  2444.44 .   .   .    L    .  60 DROP/MIN, CLEAR AMBER
1027   03     7   29    1    5   40   03T   0        . .   .   .    L    .  0.1 L/M, NOT SCREENED
1028          7   29    1    5   40   03T   0        . .   .   .    L    .  NO LQ LKS, NOT RESCREENED
1028          7   18    1    5   40   03T   0     0.00 .   .   .    L    .
1027   03     7   18    1    5   40   03T   0  1833.33 .   .   .    L    .  0.5 LITER/MIN (EST)
1065          7   18    1    5   01   04T   0     0.00 .   .   .    L    .
1066          7   18    1    5   01   04T   0     0.00 .   .   .    L    .
1067          7   18    1    5   01   04T   0     0.00 .   .   .    L    .
758           7   21    1    5   01   04T   9     0.00 .   .   .    L    .
1006          7   18    1    5   03   04T   3     0.00 .   .   .    G    .
1060          7   18    1    5   03   04T   0     0.00 .   .   .    L    .
1003          7   18    1    5   10   04T   3     0.00 .   .   .    G    .
1005          7   18    1    5   10   04T   3     0.00 .   .   .    G    .
1061          7   18    1    5   10   04T   0     0.00 .   .   .    L    .
1062          7   18    1    5   10   04T   0     0.00 .   .   .    L    .
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                                     KOSOVO SCREENING DATA        16:04 MONDAY, AUGUST 17, 1981   30

ID    CCODE MONTH DAY TEAM UNIT FIT STREAM HT    OVA    CO NH3 H2S STATE CN                SCOM

 690          7   18   2    5   10   04T   8    0.000  .   .   .    L    .
 691          7   18   2    5   10   04T   9    0.000  .   .   .    L    .
 692          7   18   2    5   10   04T   9    0.000  .   .   .    L    .
 693          7   18   2    5   10   04T   9    0.000  .   .   .    L    .
 716          7   18   2    5   10   04T   7    0.000  .   .   .    L    .
 717          7   18   2    5   10   04T   7    0.000  .   .   .    L    .
 718          7   18   2    5   10   04T   7    0.000  .   .   .    L    .
 719          7   18   2    5   10   04T   7    0.000  .   .   .    L    .
 720          7   18   2    5   10   04T   7    0.000  .   .   .    L    .
 976          7   18   1    5   10   04T   1    0.000  .   .   .    L    .
 977          7   18   1    5   10   04T   1    0.000  .   .   .    L    .
 978          7   18   1    5   10   04T   3    0.000  .   .   .    L    .
1059          7   18   1    5   11   04T   0    0.000  .   .   .    L    .
1063          7   18   1    5   11   04T   0    0.000  .   .   .    L    .
1064          7   18   1    5   11   04T   0    0.000  .   .   .    L    .
 689          7   18   2    5   11   04T   8    0.000  .   .   .    L    .
 694          7   18   2    5   11   04T   9    0.000  .   .   .    L    .
1029          7   29   1    5   40   04T   0     .     .   .   .    L    .  NO LQ LKS, NOT RESCREENED
1030          7   29   1    5   40   04T   0     .     .   .   .    L    .  NO LQ LKS, NOT RESCREENED
1029          7   18   1    5   40   04T   0    0.000  .   .   .    L    .
1030          7   18   1    5   40   04T   0    0.000  .   .   .    L    .
1071          7   18   1    5   01   05T   0    0.000  .   .   .    L    .
1072          7   18   1    5   01   05T   0    0.000  .   .   .    L    .
1052          7   18   1    5   03   05T   0    0.000  .   .   .    L    .
1051          7   18   1    5   10   05T   0    0.000  .   .   .    L    .
1053          7   18   1    5   10   05T   0    0.000  .   .   .    L    .
 982          7   18   1    5   10   05T   1    0.000  .   .   .    L    .
1049          7   18   1    5   11   05T   0    0.000  .   .   .    L    .
1050          7   18   1    5   11   05T   0    0.000  .   .   .    L    .
1026   03     7   18   1    5   30   05T   0  366.667  .   .   .    L    .
1025          7   18   1    5   40   05T   0    0.000  .   .   .    L    .  0.5 LITER/MIN (EST)
1025   03     7   29   1    5   40   05T   0    0.000  .   .   .    L    .
1026   03     7   29   1    5   40   05T   0  488.889  .   .   .    L    .  92 DROPS/MIN
                                                                          116 DROPS/MIN
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APPENDIX H.2

REPEAT SCREENING DATA

(Daily screening of specific valves
for quality control data)

KOSOVO REPEAT SCREENING DATA 16:04 MONDAY, AUGUST 17, 1981 31

ID	CCODE	MONTH	DAY	TEAM	UNIT	FIT	STREAM	HT	OVA	CO	NH3	H2S	STATE	CN	SCOM
37		7	14	1	2	10	02R	2	42778	.	.	.	G	.	P=19 T=20
37		7	14	2	2	10	02R	2	85556	.	.	.	G	.	P=19 T=20
37		7	15	1	2	10	02R	2	61111	.	.	.	G	.	P=20 T=20
37		7	15	2	2	10	02R	2	122223	.	.	.	G	.	P=20 T=20
37		7	16	1	2	10	02R	2	67222	.	.	.	G	.	P=20 T=20
37		7	16	2	2	10	02R	2	36667	.	.	.	G	.	P=20 T=20
37		7	17	1	2	10	02R	2	36667	.	.	.	G	.	P=16 T=20
37		7	17	2	2	10	02R	2	24444	.	.	.	G	.	P=16 T=20
37		7	18	1	2	10	02R	2	22000	.	.	.	G	.	P=11 T=20
37		7	18	2	2	10	02R	2	36667	.	.	.	G	.	P=11 T=20
37		7	21	1	2	10	02R	2	55000	.	.	.	G	.	P=16 T=19
37		7	21	2	2	10	02R	2	36667	.	.	.	G	.	P=16 T=19
37		7	22	1	2	10	02R	2	36667	.	.	.	G	.	P=7 T=20
37		7	22	1	2	10	02R	2	36667	.	.	.	G	.	P=12 T=19
37		7	22	2	2	10	02R	2	8556	.	.	.	G	.	P=7 T=20
37		7	23	2	2	10	02R	2	85556	.	.	.	G	.	P=12 T=19
37		7	24	1	2	10	02R	2	24444	.	.	.	G	.	P=20 T=19
37		7	24	2	2	10	02R	2	61111	.	.	.	G	.	P=20 T=19
37		7	25	1	2	10	02R	2	85556	.	.	.	G	.	P=20 T=19
37		7	25	2	2	10	02R	2	73333	.	.	.	G	.	P=20 T=19
37		7	26	1	2	10	02R	2	122223	.	.	.	G	.	P=19 T=19
37		7	26	2	2	10	02R	2	122223	.	.	.	G	.	P=19 T=19
37		7	27	1	2	10	02R	2	30556	.	.	.	G	.	P=16 T=19
37		7	27	2	2	10	02R	2	36667	.	.	.	G	.	P=16 T=19
37		7	29	1	2	10	02R	2	61111	.	.	.	G	.	P=14 T=19
37		7	29	2	2	10	02R	2	36667	.	.	.	G	.	P=14 T=19
44		7	14	1	2	10	02R	1	48889	.	.	.	G	.	P=19 T=20
44		7	14	2	2	10	02R	1	122223	.	.	.	G	.	P=19 T=20
44		7	15	1	2	10	02R	1	61111	.	.	.	G	.	P=20 T=20
44		7	15	2	2	10	02R	1	122223	.	.	.	G	.	P=20 T=20
44		7	16	1	2	10	02R	1	122222	.	.	.	G	.	P=20 T=20
44		7	16	2	2	10	02R	1	85556	.	.	.	G	.	P=20 T=20
44		7	17	1	2	10	02R	1	36667	.	.	.	G	.	P=16 T=20
44		7	17	2	2	10	02R	1	61111	.	.	.	G	.	P=16 T=20
44		7	18	1	2	10	02R	1	24444	.	.	.	G	.	P=11 T=20
44		7	18	2	2	10	02R	1	6111	.	.	.	G	.	P=11 T=20
44		7	21	1	2	10	02R	1	36667	.	.	.	G	.	P=16 T=19
44		7	21	2	2	10	02R	1	48889	.	.	.	G	.	P=16 T=19
44		7	22	1	2	10	02R	1	3667	.	.	.	G	.	P=7 T=20
44		7	22	2	2	10	02R	1	3667	.	.	.	G	.	P=7 T=20
44		7	23	1	2	10	02R	1	48889	.	.	.	G	.	P=12 T=19
44		7	23	2	2	10	02R	1	61111	.	.	.	G	.	P=12 T=19
44		7	24	1	2	10	02R	1	61111	.	.	.	G	.	P=20 T=19
44		7	24	2	2	10	02R	1	122223	.	.	.	G	.	P=20 T=19

RADIAN
CORPORATION

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                                   KOSOVO REPEAT SCREENING DATA       16:04 MONDAY, AUGUST 17, 1981   32

ID  CCODE  MONTH  DAY  TEAM  UNIT  FIT  STREAM  HT     OVA  CO  NH3  H2S  STATE  CN    SCOM

44           7    25    1     2    10    02R    1    24444   .    .    .    G     .   P=20 T=19
44           7    25    2     2    10    02R    1   122223   .    .    .    G     .   P=20 T=19
44           7    26    1     2    10    02R    1   122223   .    .    .    G     .   P=19 T=19
44           7    26    2     2    10    02R    1   122223   .    .    .    G     .   P=19 T=19
44           7    27    1     2    10    02R    1    48889   .    .    .    G     .   P=16 T=19
44           7    27    2     2    10    02R    1    42778   .    .    .    G     .   P=16 T=19
44           7    29    1     2    10    02R    1     8556   .    .    .    G     .   P=14 T=19
44           7    29    2     2    10    02R    1    12222   .    .    .    G     .   P=14 T=19
57           7    14    1     2    10    02R    2     8556   .    .    .    G     .   P=19 T=20
57           7    14    2     2    10    02R    2   122222   .    .    .    G     .   P=19 T=20
57           7    15    1     2    10    02R    2    61111   .    .    .    G     .   P=20 T=20
57           7    15    2     2    10    02R    2    24444   .    .    .    G     .   P=20 T=20
57           7    16    1     2    10    02R    2     3667   .    .    .    G     .   P=20 T=20
57           7    16    2     2    10    02R    2     2444   .    .    .    G     .   P=20 T=20
57           7    17    1     2    10    02R    2    14667   .    .    .    G     .   P=16 T=20
57           7    17    2     2    10    02R    2    30556   .    .    .    G     .   P=16 T=20
57           7    18    1     2    10    02R    2    24444   .    .    .    G     .   P=11 T=20
57           7    18    2     2    10    02R    2    61111   .    .    .    G     .   P=11 T=20
57           7    21    1     2    10    02R    2     3667   .    .    .    G     .   P=16 T=19
57           7    21    2     2    10    02R    2     2444   .    .    .    G     .   P=16 T=19
57           7    22    1     2    10    02R    2    30556   .    .    .    G     .   P=7 T=20
57           7    22    2     2    10    02R    2    24444   .    .    .    G     .   P=7 T=20
57           7    23    1     2    10    02R    2    61111   .    .    .    G     .   P=12 T=19
57           7    23    2     2    10    02R    2   110000   .    .    .    G     .   P=12 T=19
57           7    24    1     2    10    02R    2    85556   .    .    .    G     .   P=20 T=19
57           7    24    2     2    10    02R    2    61111   .    .    .    G     .   P=20 T=19
57           7    25    1     2    10    02R    2    97778   .    .    .    G     .   P=20 T=19
57           7    25    2     2    10    02R    2   122222   .    .    .    G     .   P=20 T=19
57           7    26    1     2    10    02R    2   122223   .    .    .    G     .   P=19 T=19
57           7    26    2     2    10    02R    2   122223   .    .    .    G     .   P=19 T=19
57           7    27    1     2    10    02R    2    18333   .    .    .    G     .   P=16 T=19
57           7    27    2     2    10    02R    2    18333   .    .    .    G     .   P=16 T=19
57           7    29    1     2    10    02R    2     8556   .    .    .    G     .   P=14 T=19
57           7    29    2     2    10    02R    2     6111   .    .    .    G     .   P=14 T=19
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APPENDIX H.3
LIQUID LEAK DATA

RADIAN
CORPORATION

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                                        KOSOVO LIQUID LEAK DATA       16:04 MONDAY, AUGUST 17, 1981   35

ID    CCODE MONTH DAY TEAM UNIT FIT STREAM HT       OVA    CO NH3  H2S STATE  CN SCOM

1210   02      7   23    1    1  01   01G   9    2444.4     .   .   150   G     .
1211   02      7   23    1    1  01   01G   9   61111.1     .   .  7000   G     .
1161   02      7   22    1    1  10   01G   9    2444.4  2500   .   800   G     .
1231   02      7   22    1    1  01   03G   5       0.0     .   .     .   L     .
1232   02      7   22    1    1  01   03G   5       0.0     .   .     .   L     .
1233   02      7   22    1    1  01   03G   5       0.0     .   .     .   L     .
1234   02      7   22    1    1  01   03G   5       0.0     .   .     .   L     .
1296   02      7   24    1    1  03   03G   8       0.0     .   .     .   L     .
1274   02      7   23    1    1  10   03G   9       0.0     .   .     .   L     .
1290   02      7   24    1    1  10   03G   9       0.0     .   .     .   L     .
1303   02      7   24    1    1  10   03G   5       0.0     .   .     .   L     .
1306   02      7   24    1    1  10   03G   5       0.0     .   .     .   L     .
1304   02      7   24    1    1  11   03G   5       0.0     .   .     .   L     .
1305   02      7   24    1    1  11   03G   5       0.0     .   .     .   L     .
1309   02      7   24    1    1  11   03G   5       0.0     .   .     .   L     .
1310   02      7   24    1    1  11   03G   5       0.0     .   .     .   L     .
1311   03      7   24    1    1  36   03G   5       0.0     .   .     .   L     .
1312   03      7   24    1    1  36   03G   5       0.0     .   .    50   L     .
1315   03      7   24    1    1  36   03G   5       0.0     .   .     .   L     .
1316   03      7   24    1    1  36   03G   5       0.0     .   .     .   L     .
1317   02      7   24    1    1  46   03G   0      73.3     .   .     .   L     .
1318   02      7   24    1    1  46   03G   0      73.3     .   .     .   L     .
836    02      7   16    1    2  03   04R   1    1222.2     .   .     .   L     . 60 DROP/MIN
1147   02      7   21    1    2  03   04R   5    6111.1     .   .   150   L     .
444    02      7   15    2    2  03   04R   1    6111.1     .   .     0   L     .
570    02      7   16    2    2  03   04R   1    8555.6     .   .   100   L     .
574    02      7   16    2    2  03   04R   1   24444.4     .   .   100   L     .
513    02      7   16    2    2  10   04R   1     611.1     .   .     .   L     .
568    02      7   16    2    2  10   04R   1    1833.3     .   .     0   L     .
806    02      7   16    1    2  10   04R   1    3666.7     .   .     0   L     . 30 DROP/MIN
225    02      7   15    1    2  10   04R   1    4888.9     .   .   160   L     . SLOWDRIP TO GROUND
453    02      7   15    2    2  10   04R   1   30555.6     .   .  1400   L     .
296    02      7   16    1    2  30   04R   1    3666.7     .   .     .   L     . 600 DROP/MIN
290    02      7   21    2    2  30   04R   1   73333.3     .   .     .   L     .
290    02      7   21    2    2  30   04R   1   73333.3     .   .     .   L     .
287    02      7   16    1    2  33   04R   1     122.2     .   .     .   L     . 600 DROP/MIN
289    02      7   16    1    2  33   04R   1     122.2     .   .     .   L     . 6 DROP/MIN
285    02      7   16    1    2  33   04R   1     855.6     .   .     .   L     . 0.5 LITER/MIN
290    02      7   16    1    2  35   04R   1   61111.1     .   .     .   L     . 3 DP/MIN, CASE LKS GAS
297    02      7   16    1    2  40   04R   1       0.0     .   .     .   L     . 60 DROP/MIN
281    02      7   16    1    2  40   04R   1     244.4     .   .     .   L     . 1 DROP/MIN
296    02      7   22    2    2  40   04R   1    7944.4     .   .     .   L     .
296    02      7   22    2    2  40   04R   1   61111.1     .   .    95   L   151
284    02      7   16    1    2  42   04R   1    3666.7     .   .     0   L     . 6 DP/MIN,CASE LKS GAS
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RADIAN
CORPORATION

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                                       KOSOVO LIQUID LEAK DATA       16:04 MONDAY, AUGUST 17, 1981   36

 ID    CCODE MONTH DAY TEAM UNIT FIT STREAM HT OVA      CO NH3 H2S STATE CN SCOM

 288    02     7    16    1    2   43   04R   1  1222.22 .   .   .    L   .  6 DROP/MIN
 547    02     7    16    2    2   03   05R   1     0.00 .   .   .    L   .
 292    02     7    16    1    2   30   06R   1     0.00 .   .   .    L   .  SMALL STEADY STREAM (2MM)
 293    02     7    16    1    2   40   06R   1     0.00 .   .   .    L   .  600 DROP/MIN
 506    02     7    16    2    2   11   07R   1   611.11 .   .   0    L   .
 405    03     7    14    2    3   03   01P   1    36.67 .   .   .    L   .
 181    03     7    14    1    3   10   01P   1     0.00 .   .   .    L   .
 170    03     7    14    1    3   30   01P   1     0.00 .   .   .    L   .
 176    03     7    14    1    3   30   01P   1  1222.22 .   .   .    L   .
 387    02     7    14    2    3   10   02P   1     0.00 .   .   .    L   .
 400    03     7    14    2    3   36   02P   1  1222.22 .   .   .    L   .
 400    03     7    17    2    3   36   02P   1  4888.89 .   8   .    L   .
 400    03     7    17    2    3   36   02P   1  5500.00 .   .   .    L   .
 105    02     7    14    1    3   03   03P   9   611.11 .   .   .    L   .
 1024   03     7    18    1    5   30   01T   0   183.33 .   .   .    L   .  2 LITER/MIN (EST)
 1021   03     7    29    1    5   33   01T   0   366.67 .   .   .    L   .  0.2 L/M SEAL, 0.9 L/M CWATR
 1018   03     7    29    1    5   33   01T   0   733.33 .   .   .    L   .  6.6 L/M FK 2 SEALS INC. CW
 1018   03     7    18    1    5   33   01T   0   855.56 .   .   .    L   .  1 LITER/MIN (EST)
 1021   03     7    18    1    5   33   01T   0   855.56 .   .   .    L   .  1 LITER/MIN (EST)
 739    02     7    18    2    5   11   02T   9     0.00 .   .   .    G   .  26 DROP/MIN
 741    02     7    18    2    5   11   02T   9     0.00 .   .   .    G   .  15 DROP/MIN
 987    03     7    18    1    5   10   03T   1  1222.22 .   .   .    L   .  60 DROP/MIN, CLEAR AMBER
 1027   03     7    29    1    5   40   03T   0        . .   .   .    L   .  0.1 L/M, NOT SCREENED
 1027   03     7    18    1    5   40   03T   0  1833.33 .   .   .    L   .  0.5 LITER/MIN (EST)
 1026   03     7    18    1    5   30   05T   0   366.67 .   .   .    L   .  0.5 LITER/MIN (EST)
 1025   03     7    29    1    5   40   05T   0     0.00 .   .   .    L   .  92 DROPS/MIN
 1026   03     7    29    1    5   40   05T   0   488.89 .   .   .    L   .  116 DROPS/MIN
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APPENDIX H.4

RESCREENING DATA

(Screening done immediately before and after sampling)

RADIAN
CORPORATION

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                                  KOSOVO RESCREENING DATA       16:04 MONDAY, AUGUST 17, 1981   33

ID   CCODE MONTH DAY TEAM UNIT FIT STREAM HT    OVA     CO NH3 H2S STATE  CN SCOM

227          7   23   2    2   10   04R   1    6111      .  .    .   L     .
227          7   23   2    2   10   04R   1    7333      .  .  160   L     .
290   02     7   21   2    2   30   04R   1   73333      .  .    .   L     .
290   02     7   21   2    2   30   04R   1   73333      .  .    .   L     .
296   02     7   22   2    2   40   04R   1    7944      .  .    .   L     .
296   02     7   22   2    2   40   04R   1   61111      .  .   95   L   151
32           7   25   2    2   10   02R   7  122223  70001  .    .   G     .
32           7   25   2    2   10   02R   7  122223  70001  .    .   G     .
32           7   26   2    2   10   02R   7  122223  70001  .    .   G     .
32           7   26   2    2   10   02R   7  122223  70001  .    .   G     .
35           7   27   2    2   10   02R   1  122223  70001  .    .   G     .
35           7   27   2    2   10   02R   1  122223  70001  .    .   G     .
400   03     7   17   2    3   36   02P   1    4889      .  8    .   L     .
400   03     7   17   2    3   36   02P   1    5500      .  .    .   L     .
44           7   27   2    2   10   02R   1   42778   8000  .    .   G     .
44           7   27   2    2   10   02R   1   30556  10000  .    .   G     .
44           7   27   2    2   10   02R   1   18333   3100  .    .   G     .
44           7   27   2    2   10   02R   1   12222   5000  .    .   G     .
453          7   24   2    2   21   04R   2    9778      .  0  600   L    12
453          7   24   2    2   21   04R   2       .      .  .    .   L     . NOT RESCREENED
51           7   27   2    2   10   02R   1  122223  35000  .    .   G     .
51           7   27   2    2   10   02R   1  122223  36000  .    .   G     .
513          7   24   2    2   10   04R   1     244      .  .    .   L     . NOT SAMPLED
523          7   24   2    2   10   04R   1    2811      .  .  180   L     .
523          7   24   2    2   10   04R   1    5500      .  .  175   L     .
56           7   27   2    2   10   02R   2    3056    200  .    .   G     .
56           7   27   2    2   10   02R   2    2811    900  .    .   G     .
568          7   24   2    2   10   04R   2    6111      .  .    0   L     .
568          7   24   2    2   10   04R   2    6722      .  .    .   L     .
568          7   25   2    2   10   04R   2    3056      .  .    .   L     . UNABLE TO RESAMPLE
62           7   24   2    2   21   02R   6  122223  35000  .    .   G     .
62           7   24   2    2   21   02R   6  122223  70000  .    .   G     .
63           7   26   2    2   10   02R   7   30556  24000  .    .   G     .
634          7   22   2    2   01   04R   1    9778      .  0  180   L    10
634          7   22   2    2   01   04R   1   11000      .  .  250   L     .
64           7   26   2    2   10   02R   7   73333  38000  .    .   G     .
64           7   26   2    2   10   02R   7   42778   4000  .    .   G     .
82           7   25   2    2   10   02R   7   13444   8000  .    .   G     .
82           7   25   2    2   10   02R   7   15889  21000  .    .   G     .
831          7   23   2    2   10   04R   1     733      .  .    0   L     .
831          7   23   2    2   10   04R   1     978      .  .    .   L     .
834          7   23   2    2   15   04R   1    3667      .  .    0   L     . CHECK VALVE
834          7   23   2    2   15   04R   1    3300      .  .    .   L     . CHECK VALVE
862          7   23   2    2   10   04R   0    6111      .  .    .   L     .
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RADIAN
CORPORATION

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                                        KOSOVO RESCREENING DATA       16:04 MONDAY, AUGUST 17, 1981   34

ID    CCODE   MONTH   DAY   TEAM   UNIT   FIT   STREAM   HT        OVA      CO   NH3   H2S   STATE   CN   SCOM

862               7    23     2      2    10     04R     0      4888.9      .     .     .     L      .
942               7    25     2      2    01     02R     7     15888.9  25000     .     .     G      .
942    01         7    25     2      2    01     02R     7     12222.2  15000     .     .     G      .
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APPENDIX H.5
SAMPLING DATA

RADIAN
CORPORATION

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                                        KOSOVO SAMPLING DATA        16:04 MONDAY, AUGUST 17, 1981   37
ID  CI MONTH DAY STREAM TEAM UNIT FIT   BOVA RESCREN1 BCON  FLOW  TEMP1 EXITEMP PRES COMMENT BARO

942 1    7   25   02R    2    2   01   12222   2     15000 0.720  21     24     2.3     1    712
32  1    7   25   02R    1    2   10  122223   2     70001 0.554  23     24     3.3     5    712
35  1    7   27   02R    2    2   10  122223   2     70001 1.620  29     33     4.3     5    713
44  1    7   27   02R    2    2   10   42778   2      8000 0.841  29     31     1.0     5    713
51  1    7   27   02R    2    2   10  122223   2     35000 1.820  32     33     3.5     5    713
56  1    7   27   02R    2    2   10    3056   2       200 0.207  32     32     1.0     5    713
63  1    7   26   02R    2    2   10   30556   2     24000 0.749  27     26     8.0     5    713
64  1    7   26   02R    2    2   10   73333   2     38000 0.433  22     27     1.3     4    713
82  1    7   25   02R    2    2   10   13444   2      8000 0.426  23     23     1.6     5    712
62  1    7   24   02R    2    2   21  122223   2     35000 1.180  21     21     2.2     4    711
634 1    7   22   04R    2    2   01    9778   4       180 2.030  19     15     2.0     .    710
227 1    7   23   04R    2    2   10    6111   .         . 0.400  21     22     0.6     .    713

ID   TENTPRES   OGM     INOVA OVANO SAMPCOM                  SOVA   SCO SNH3 SH2S SH2SSO2 SRSH SCN   AOVA

942    2.1    1.00429  3.6667  2  CLEAN GAS                  427.8   500   .    .     .     .    .  15889
32     3.1    1.00245  3.6667  2  EXTRA SMPL NOT RND     20777.8 34000   .    .     .     .    . 122223
35     3.4    1.01428  6.1111  2  CLEAN GAS                 6722.2  9000   .    .     .     .    . 122223
44     0.8    1.00564  6.1111  2  CLEAN GAS                  207.8   310   .    .     .     .    .  30556
51     2.7    1.01650  6.1111  2  CLEAN GAS                  611.1   500   .    .     .     .    . 122223
56     0.8    0.99860 11.0000  2  CLEAN GAS                  134.4    80   .    .     .     .    .   2811
63     7.8    1.00461  3.6667  2  EXTRA SMPL NOT RND      2444.4  4000   .    .     .     .    .      .
64     1.2    1.00111  2.4444  2  CLEAN GAS                 2444.4  4000   .    .     .     .    .  42778
82     1.4    1.00103  3.6667  2  CLEAN GAS                  611.1   700   .    .     .     .    .  15889
62     1.7    1.00940  3.6667  2  CLEAN GAS                 2444.4  4000   .    T     .     .    . 122223
634    0.9    1.01883  3.6667  2  BTMS D5                    611.1     .   0   50     .     .    2  11000
227    0.3    1.00074  3.6667  2  CND IN TENT BAG OK        1588.9     .   .    T     .     .    .   7333

ID    RESCREN2   ACON   RESRNCOM                HCLK        COLK       MEOHLK      PHLK     HCLEAK    TTLHCLK

942      2      25000                        0.0003263   0.0006732      .           .     0.000327  0.000327
32       2      70001                        0.0122237   0.0350103      .           .     0.012225  0.012225
35       2      70001                        0.0115058   0.0269822      .           .     0.011507  0.011507
44       2      10000                        0.0001763   0.0004743      .           .     0.000177  0.000177
51       2      36000                        0.0011531   0.0016677      .           .     0.001154  0.001154
56       2        900                        0.0000261   0.0000296      .           .     0.000027  0.000027
63       .          .   NOT SCRN AFTR SAMPL  0.0019461   0.0055813      .           .     0.001947  0.001947
64       2       4000                        0.0011211   0.0032135      .           .     0.001122  0.001122
82       2      21000                        0.0002732   0.0005510      .           .     0.000274  0.000274
62       2      70000                        0.0030880   0.0088561      .           .     0.003089  0.003089
634      4        290                            .           .       0.017058       .     0.017059  0.017059
227      4        160   RFLX TO D71              .           .       0.007982       .     0.007983  0.007983
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RADIAN CORPORATION

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                            KOSOVO SAMPLING DATA           16:04 MONDAY, AUGUST 17, 1981   38

                              R                            T
                              E              E     C       E                   S
            S                 S              X     O       N                   A
      M     T                 C           T  I     M       T               I O M
      O     R  T U         B  R   B    F  E  T   P M   B   P               N V P
      N  D  E  E N  F      O  E   C    L  M  E   R E   A   R       D       O A C
 I  C T  A  A  A I  I      V  N   O    O  P  M   E N   R   E       G       V N O
 D  I H  Y  M  M T  T      A  1   N    W  1  P   S T   O   S       M       A O M

523 1 7 24 04R 2 2 10  2811.1 4 180 0.81 22 24 0.5 . 711 0.2 1.00529  3.0556 2 RFLX TO D71
568 1 7 24 04R 2 2 10  6111.1 4   0 2.71 21 19 3.7 . 711 1.0 1.02638  3.6667 2 STEM ONLY GLD GRTR
831 1 7 23 04R 2 2 10   733.3 4   0 0.43 19 20 0.8 . 713 0.5 1.00107  3.6667 2 BTMS D71
862 1 7 23 04R 2 2 10  6111.1 .   . 0.98 20 18 1.0 . 713 0.5 1.00718  4.8889 2 METHANOL TANKS
834 1 7 23 04R 2 2 15  3666.7 4   0 0.57 19 31 1.1 . 713 0.8 1.00263  2.4444 2 BTMS D71
453 1 7 24 04R 2 2 21  9777.8 4 600 0.94 21 21 2.6 . 711 2.1 1.00673  3.6667 2 BTMS OF D1 TOP STG
290 1 7 21 04R 2 2 30 73333.3 .   . 2.76 32 50 2.7 2 710 0.4 1.02694  9.7778 2 OTBRD SL ONLY
296 1 7 22 04R 2 2 40  7944.4 .   . 6.43 23 28 8.0 2 710 0.5 1.06297  4.8889 2 155 ML PER MIN
400 1 7 17 02P 2 3 36  4888.9 3   8 2.41 30 30 2.0 3 714 0.1 1.01646 12.2222 2 38 ML PER MIN TORN

                                    R     R
                    S               E     E                                                   T
                    H               S     S                              M                  H T
                    2               C     R                              E                  C L
          S   S   S S S           A R   A N                   H C        O         P        L H
          O S N   H S R   S       O E   C C                   C O        H         H        E C
 I        V C H   2 O S   C       V N   O O                   L L        L         L        A L
 D        A O 3   S 2 H   N       A 2   N M                   K K        K         K        K K

523  146.67 . .  10 . .   .  5500.0 4 175                     . . 0.001742 .         0.001743 0.001743
568  134.44 . .   . . .   .  6722.2 .   . BTM OF D40          . . 0.005520 .         0.005521 0.005521
831   67.22 . .   . . .   .   977.8 .   .                     . . 0.000439 .         0.000440 0.000440
862  220.00 . .   . . .   .  4888.9 .   .                     . . 0.003104 .         0.003105 0.003105
834  134.44 . .   0 . .   .  3300.0 .   . CK VLV W EXT WEIGHT . . 0.001147 .         0.001148 0.001148
453  268.89 . .  50 . .   .       . .   . NOT SCRN AFTR SAMPL . . 0.003607 .         0.003608 0.003608
290 1588.89 . .   0 . .   . 73333.3 .   . BTMS D71            . . 0.054354 .         0.054355 0.054355
296 2688.89 . 0 200 . . 110 61111.1 4  95 HCN 151 BTMS D5     . . 0.223886 .         0.223887 0.223887
400  501.11 . 0   0 . .   .  5500.0 .   . MAX=GLAND/CASE JNCT . .  .       0.0249641 0.024965 0.024965
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APPENDIX H.6

REPEAT SAMPLING DATA

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                                  KOSOVO REPEAT SAMPLING DATA      16:04 MONDAY, AUGUST 17, 1981   39

                             R                                 T
                             E                E         C      E                    S
            S                S                X         O      N                    A
      M     T                C             T  I         M      T             I    O M
      O     R  T U         B R   B     F   E  T  P      M  B   P             N    V P
      N D   E  F N F       O E   C     L   M  E  R      E  A   R    D        O    A C
I   C T A   A  A I I       V N   O     O   P  M  E   Q  N  R   E    G        V    N O
D   I H Y   M  M T T       A 1   N     W   1  P  S   C  T  O   S    M        A    O M

942 1 7 25 02R 2 2 01  12222 2 15000 1.570 21 24 8.2 R2 1 712 7.2 1.01373 3.66667 2 CLEAN GAS
942 1 7 25 02R 2 2 01  12222 2 15000 1.220 21 23 5.3 R1 1 712 4.9 1.00984 3.66667 2 CLEAN GAS
32  1 7 26 02R 2 2 10 122223 2 70001 0.612 25 28 9.5 Q1 5 713 9.1 1.00309 3.66667 2 CLEAN GAS
44  1 7 27 02R 2 2 10  18333 2  3100 0.116 31 32 0.1 Q1 5 713 0.2 0.99759 6.11111 2 CLEAN GAS
64  1 7 26 02R 2 2 10  73333 2 38000 1.530 24 27 2.9 R2 4 713 2.1 1.01328 2.44444 2 CLEAN GAS
64  1 7 26 02R 2 2 10  73333 2 38000 0.619 24 27 1.9 R1 4 713 1.6 1.00317 2.44444 2 CLEAN GAS
56A 1 7 25 04R 1 2 10   3056 .     .     .  .  .   . Q1 4   .   .       .       . . NOT SAMPLED

                                   R       R
                      S            E       E                                    T
                      H            S       S                     M   H          T
                      2            C       R                     E   C          L
        S         S S S S     A  R    A  N H          C        O P L          H
        U       S N H S R S   O  E    C  C C          O        H H E          C
I       V       C H 2 O S C   V  N    O  O L          L        L L A          L
D       A       O 3 S 2 H N   A  2    N  M K          K        K K K          K

942   171.1   120 . . . . .  15889 2 25000   0.0002879 0.0003611 . . 0.0002889 0.0002889
942   268.9   300 . . . . .  15889 2 25000   0.0003504 0.0006936 . . 0.0003514 0.0003514
32  15888.9 27000 . . . . . 122223 2 70001   0.0104428 0.0310618 . . 0.0104438 0.0104438
44    146.7    80 . . . . .  12222 2  5000   0.0000167 0.0000166 . . 0.0000177 0.0000177
64    892.2  1800 . . . . .  42778 2  4000   0.0014571 0.0051585 . . 0.0014581 0.0014581
64   1466.7  3200 . . . . .  42778 2  4000   0.0009579 0.0036637 . . 0.0009589 0.0009589
56A       .     . . . . . .      . .     .           .         . . .         .         .
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